Marx and scientific realism: a Lockean perspective

by

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Summary

In this thesis I argue for two main conclusions about Marx's critique of political economy in Volume 1 of *Capital*: (1) While Marx's critique of political economy is not an exact science like Newton's mathematical physics, it is nevertheless a precursor of modern scientific realism since it endeavours to uncover the underlying essence of phenomena (their causal foundations) which lies hidden behind their appearances (the observable features of phenomena): it anticipates the central aim of modern scientific realism. (2) Marx's scientific analysis of capitalism is very Lockean, since both Marx and Locke each draw a distinction between the observable features of phenomena and their causal foundations: for Marx, this is done in terms of his Hegelian distinction between appearance and essence, while for Locke it is done in terms of his distinction between the nominal and real essences of things. Prior to this, I consider the question about whether the true epistemological source of positivism is Locke's empiricism or Hume's empiricism, as this needs to be done if we are to accept the claim that Marx's critique of capitalism is very Lockean. I show that it is Hume's empiricism since all positivists from Mach through to Poincaré, Duhem and the logical positivists like Schlick, Hahn, Neurath, Carnap, Feigl, etc. all accepted Hume's basic epistemological principle about how there can be no idea of anything unless based on an impression of it. As such, since we can have no idea of the hidden essence of phenomena, it should be discarded as unknowable. Science should just focus on the observable 'law-like' regularities of the phenomena of the world. And the reason why Locke's empiricism is not the basis of modern positivism is because it is ambiguous between positivism *and* scientific realism. Locke's empiricism provides us with a basis for not just inferring the actual existence of the unknown essences of phenomena on the basis of his theory of ideas but also speculating about what sorts of primary qualities they might possess and how they might interact with each other to produce the specific secondary qualities of things (as exemplified by the inner 'corpuscular' constitution of gold and how it produces its specific observable properties like its colour, hardness, etc.). This thesis concludes on the note that if you want to give a scientific analysis of the phenomena of capitalism then you need to go beyond immediate experience (appearances) to acquire some theoretical knowledge of how things really are (essence).

Declaration

I certify that this thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Stephen M. Darling 16th August 2019

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In memoriam: Brian Medlin (1927-2004) – the Foundation Professor of Philosophy at Flinders University

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I dedicate this thesis to my wife, Véronique Perrin.

Preface and outline

1 The two main conclusions of the thesis

In this thesis I shall argue for two main conclusions about Marx's critique of political economy in Volume 1 of *Capital*:

1. While Marx's critique of political economy is not an exact science like Newton's mathematical physics, it is nevertheless a precursor of modern scientific realism since it endeavours to uncover the underlying essence of phenomena (their causal foundations) which lies hidden behind their appearances (the observable features of phenomena): it anticipates the central aim of modern scientific realism.
2. Marx's scientific analysis of capitalism is very Lockean, since both Marx and Locke each draw a distinction between the observable features of phenomena and their causal foundations: for Marx, this is done in terms of his Hegelian distinction between appearance and essence, while for Locke it is done in terms of his distinction between the nominal and real essences of things.

This thesis will conclude on the note that if you want to give a scientific analysis of the phenomena of capitalism then you need to go beyond immediate experience (appearances) to acquire some theoretical knowledge of how things really are (essence).

2 A preliminary issue: what is the true epistemological source of positivism – Locke's empiricism or Hume's empiricism?

It is first necessary to consider what the true epistemological source of a positivist view of science is. It is an implicit view amongst some Marxists, like Zeleny (1980), Ilyenkov (1980) and Pilling (1972 and 1980), who have written on Marx's scientific methodology, that the empiricism of John Locke is the epistemological source of a positivist view of science, since it purportedly denies that we can know anything about the essences of phenomena. This view needs to be countered if we are to understand that Marx's own scientific project in his critique of political economy is very Lockean. We should therefore ask whether a positivist view of science is ultimately based on John Locke's empiricism or David Hume's empiricism. In doing

so, I shall show that it is ultimately based on David Hume's empiricism rather than John Locke's empiricism.

The principal reason for claiming this is that the modern positivists – from Ernst Mach through to Pierre Duhem, Henri Poincaré and the logical positivists – all accepted Hume's view that the hidden essences of phenomena (the 'secret powers' which caused objects and/or events to be necessarily connected to each other) were unknowable on the basis of experience. As a result, they all rejected in their various ways any metaphysical speculations about the hidden causal mechanisms (essences) which purported to be scientific explanations of the various phenomena. In so doing, it is they who advocated that the main aim of science is to discover the observable 'law-like' connections of phenomena – which are in turn the basis for making scientific predictions about the various phenomena of the world.

Locke's empiricism is not the ultimate source of modern positivism because it is ambiguous between positivism *and* scientific realism. Locke's empiricism provides us with a basis for not just inferring the actual existence of the unknown essences of phenomena on the basis of his theory of ideas but also speculating about what sorts of primary qualities they might possess and how they might interact with each other to produce the specific secondary qualities of things (as exemplified by the inner 'corpuscular' constitution of gold and how it produces its specific observable properties like its colour, hardness, weight, etc.). Nevertheless, Locke's empiricism leads to positivism if all you focus on is how he says you can have no ideas of anything unless based on experience (as shown in his account of the names of natural substances). While this is one interpretation it overlooks the scientific realist aspect of his empiricist philosophy.

An important outcome of tracing the real epistemological source of a positivist view of science is that it highlights that *empiricism is not the problem but rather positivism is* when it comes to dealing with the question about what hinders a proper scientific account of the observable phenomena of the world. Positivism, in effect, legislates against looking for the hidden essence of phenomena – principally because such pursuits are metaphysical dead-ends. In short, anything that is not based on experience and observation is deemed to be a piece of metaphysics or metaphysical speculation.

3 The problem with positivism: an illustration from the history of modern science

Science is unable, if positivism is accepted, to scientifically explain the various observable features of phenomena. As a consequence, science must simply search for the observable constant connections of phenomena ('regularities'). The justification for such a view of science is David Hume's empiricism – whose fundamental premise is that all knowledge of the world consists of ideas derived from impressions, either by being copies of them or combinations of such copies (with the exception of cases of extrapolation, as in the missing shade of blue).

This view of science blocks it from ever attempting to discover the causal structure of phenomena. This can be illustrated by briefly focusing on one episode from the history of modern science: the scientific explanation of Brownian motion.

Brownian motion is the phenomenon which was initially observed by the early nineteenth century botanist, Robert Brown, through a microscope in 1828. Briefly, what he observed was the rapid zigzag movement of tiny microscopic pollen grains. Although Brown proffered some possible explanations for this phenomenon (such as how they all purportedly possessed 'vital forces' which propelled each of them to move around vigorously and as a result caused them to constantly bump into and bounce off each other in random ways), he was ultimately unable to explain it. An eventual scientific explanation was given through the initial theoretical work of Albert Einstein in 1905, which sought to scientifically explain the phenomenon of Brownian motion in terms of sub-microscopic particles – 'atoms' – and the subsequent experimental work of Jean Perrin which was completed by 1911, and which sought to provide the 'proofs' to scientifically support Einstein's theoretical account of it. Brownian motion is the result of the rapid movement of particles too small to be seen even through the most powerful of microscopes at the beginning of the twentieth century. This established beyond any reasonable scientific doubt the reality of the atomic-molecular make-up of matter, thereby showing that science not only aims to know the causal structure of phenomena but is able to do so – successfully!

Given this specific episode from the history of modern science, what we have here then is a clear counter-instance to the principal claim of positivism, which is that science is unable to know on Humean-empiricist grounds the hidden causal structure of phenomena. So positivism, on this point alone, is wrong as it is simply not supported by the theoretical and experimental

work of science, as exemplified by the Einstein-Perrin proof of the existence of the atomic-molecular make-up of matter.

If positivism is accepted as a plausible view of science, then science would not attempt to know the causal structure of phenomena. According to positivism, such things are simply beyond the realm of human capacity given that all we can possibly know on the basis of experience and observation are such things as the regular law-like connections of phenomena. Such pursuits are ultimately metaphysical projects as far as positivism is concerned and are not a legitimate part of any empirical science. Yet, if such a view of science is accepted as being plausible, then science would be blocked from ever really attempting to discover such things as what causally explains the phenomenon of Brownian motion. For, on their account of science, the 'atoms' which actually cause the phenomenon of Brownian motion to occur would be nothing more than pieces of metaphysical speculation – best left alone.

It is notable that one of the major reasons why there was such a resistance to accepting the reality of the atomic-molecular make-up of matter and consequently the veracity of the atomic-molecular theory of matter at the time by some scientists (e.g., Mach and Duhem) was not because there was no experimental proof in the end, but simply because this account of matter ran countered to their positivist views about science and metaphysics (see Nyhof 1988). Their positivist philosophy rather than any lack of scientific evidence prevented them from ever accepting such a scientific account of matter.

So, from the history of modern science, we have some reasons for being concerned with the philosophy of science called positivism. The lesson to draw here is that positivism is not only an unsustainable doctrine as it clashes with the real achievements of science (of actually revealing the hidden causal structure of phenomena) but also a negative, or even a destructive, one as it gets in the way of science striving to do its main job (of trying to reveal the hidden causal structure of phenomena).

As we shall see, this is not the course Marx pursues in his critique of political economy. By pursuing a Lockean course in his account of capitalism Marx implicitly rejects the views of Hume's positivist followers.

4 An outline of the chapters

The questions of this thesis are:

(1) What is the ultimate epistemological source of a positivist view of science – Locke's empiricism or Hume's empiricism?
(2) Is Marx's critique of political economy a precursor of modern scientific realism?

To answer these questions, I shall proceed as follows.

In Chapter 1, I shall start by showing that Locke's empiricism is a basis for two different trends in the philosophy of science: positivism (the view which denies the knowability of the hidden 'real essence' of phenomena) and scientific realism (the view which advocates the knowability of the hidden 'real essence' of phenomena). In doing so, this chapter will counter the view that Locke's empiricism only gives rise to a positivist trend in the philosophy of science. However, even though Locke's empiricism does also give rise to a scientific realist trend in the philosophy of science, there is nevertheless a problem with his specific account about the hidden 'real essences' of phenomena. The problem is that Locke bases his account of the hidden 'real essence' of phenomena on what is called 'metaphysical speculation'. That is, Locke does not base it on the empirical and theoretical work of actual science. Despite this problem (which leaves Locke open to the possible charge about how these hidden 'real essences' are to be known), I shall show in Chapter 2 how it is possible for science to actually know the hidden 'real essence' of phenomena via the Einstein-Perrin proof of the atomic-molecular make-up of matter: thus showing that Locke's empiricism is an epistemological basis for a sound scientific realist view within the philosophy of science.

Then, in Chapter 3, I shall show that the true epistemological source of the philosophy of science called positivism is Hume's empiricism. This is largely because modern positivists – from Mach through to Poincaré, Duhem and the logical positivists – all accepted the central claim of Hume's empiricist philosophy: that the hidden essence of phenomena is unknowable on the basis of experience and observation. As a result, science can only endeavour to know, according to positivists, the regular 'law-like' connections of phenomena; and moreover, this is the basis of developing 'covering-law' models of explanation and prediction. The goal of science is for them scientific prediction, not any 'metaphysical explanation' in terms of the hidden essence of phenomena.

From here, I shift the focus of the thesis from a consideration of problems within epistemology and the philosophy of science to a focus on Marx's critique of political economy in order to show that it is in fact a precursor of modern scientific realism.

So, in Chapter 4, I first articulate Marx's theoretical aim in Volume 1 of *Capital,* so we may grasp its theoretical rationale. Next, I shall present his account of a scientific paradigm (Newton's scientific account of the Keplerian model of the solar system) and explain why he seeks to emulate it in Volume 1 of *Capital*. Then, I shall show how and why Marx couches his theoretical project in terms of a distinction between appearance and essence – which is to uncover the essence of the capitalist mode of production which lies hidden behind its appearances. Then in Chapter 5, I show in detail how Marx uncovers the essence of the capitalist mode of production in his critique of political economy in Volume 1 of *Capital* (from Chapter 7 through to Chapter 25). This will then be followed, in Chapter 6, by a defence of Marx's critique of political economy as a precursor of contemporary scientific realism, focusing especially on such questions as whether Marx has actually uncovered the essence of the capitalist mode of production and whether his critique of capitalism is an exact science. Finally, I shall sum up how Marx's critique of political economy *is* a precursor of contemporary scientific realism and what is instructive about it.

1

The foundations of positivism: Locke's empiricism or Hume's empiricism?

1

Locke's empiricism as a basis for two trends in the philosophy of science: positivism and scientific realism

1.0 Introduction

The aim of this chapter is to show that Locke's empiricism is an epistemological basis for two trends in the philosophy of science: positivism and scientific realism.

Locke's empiricism is the view that all knowledge is based on the ideas of experience (sensation and reflection). This view gives rise to two different strands in his philosophy. The first strand is reflected in his account of how we can only ever know the nominal, and not real, essences of different sorts of things in nature as a result of knowing nothing beyond the ideas we have of the sensible qualities of external objects (via sensation). The other strand is reflected in his account of how it is possible, at least in principle, to infer some non-sensory ideas about the real essences of things on the basis of the ideas we have already acquired about the sensible qualities of external objects. That is, these sensory ideas allow us to speculate about what cannot be directly perceived via our senses, such as the unobservable minute parts of things. Given these two different strands of Locke's philosophy, it can be claimed that Locke's empiricism becomes a basis for two trends in the philosophy of science: positivism and scientific realism. Locke's empiricism is a basis for positivism because it leads to the view that denies that science can ever know the real essences of things. Equally, it is a basis for scientific realism because it leads to the view that science can in fact attempt to know the real essences of things.

To establish this conclusion, I shall first sketch out the epistemological basis of Locke's philosophy: his theory of ideas. It is Locke's view that all our ideas of things, which are the 'materials' or building blocks of knowledge and thought, have their origins in experience *via* the two principal sources of 'sensation' and 'reflection' (in other words, sense perceptions).

Then, I shall introduce Locke's all-important distinction between real and nominal essence. I shall do this because the main part of the chapter is to be structured around it. In doing so, I shall initially explain that the distinction, in general terms, is above all between the explanatory causal foundation of things and their observable features. Once this is done, I shall then proceed to articulate Locke's 'corpuscularian' conception of the distinction as it applies to the material phenomena of nature. As a consequence, it will be seen that Locke's (1988: 417) 'corpuscularian' distinction is basically between, on the one hand, the 'real ... Constitution' of a thing's 'insensible parts, from which flow' its 'sensible Qualities' and, on the other, those very 'sensible Qualities' themselves which necessarily 'flow' from its 'real ... Constitution'.

Next, I shall discuss Locke's views about how and why only nominal essences but not real essences are known on the basis of his empiricism (as evinced primarily in his classificatory account of the names of substances). This is mainly because we can have no 'ideas' of real essences in the sense that we can have of nominal essences; that is, we cannot have any direct sensory ideas of them (in short, 'ideas of sensation').

Afterwards, I shall discuss Locke's views about how and why real essences may in some way also be known on the basis of his empiricism (as evinced, for example, in his account of the corpuscularian theory of matter). Here, it will be shown that although, strictly speaking, we can have no immediate or direct 'ideas' of real essences in the way that we can have of nominal essences, we can still use the 'ideas' of experience (indirectly) to speculate about what they are probably like in terms of their particular make-up. An important component of this is, as I shall show, the role played by analogies and the use of inferences to how things probably are within Locke's metaphysical speculations about 'real essences'.

Finally, I shall explain how Locke's empiricism is a basis for two trends in the philosophy of science: positivism and scientific realism. The line towards positivism emerges out of his classificatory account of the names of substances, while the line towards scientific realism emerges out of his corpuscularian account of the primary and secondary qualities distinction.

1.1 Locke's theory of ideas: the basis of his empiricism

For Locke (1988: 105), an 'idea' of a thing simply signifies in the first place any of the various external features, qualities or properties that a '*sensible Object*' actually possesses. For instance, the external features of a piece of gold, such as its yellowness, its shininess and its hardness are some of the aspects which are directly signified by the ideas of being yellow,

being shiny and being hard. Consequently, for Locke, ideas are nothing but the immediate signs of things.

However, in order for anyone to actually acquire any ideas of the various things in the world (e.g., pieces of gold), then, according to Locke, the only readily available means is via what he calls the source of 'sensation'. For Locke, it is by way of the various senses of the human body – such as the senses of sight, touch and taste – that one comes to perceive any of the various external aspects of the sensible objects of the world, which are signified by the ideas of things. As Locke (1988: 105) says:

> *Our Senses*, [which are] conversant about particular sensible Objects, do *convey into the Mind*, several distinct *Perceptions* of things ... And thus we come by those *Ideas*, we have of *Yellow* ... *Heat* ... *Soft* ... *Sweet*, and all those sensible qualities, which ... from external Objects convey into the mind what produces there those *Perceptions* ...

So, for Locke, the source of sensation is *not only* the immediate *but also* the principal means by which we acquire our ideas of things. Yet, for Locke, it is nevertheless possible to acquire ideas of things via another source, if it is ultimately derived from the original source of the ideas of things: sensation. This other source for Locke is that of 'reflection'. This simply refers to being aware of and reflecting on the ideas of things that already reside within the human mind, which will consequently give rise to such additional 'ideas' as those which signify the 'different actings of our own Minds' (such as how we perceive, think, reason, etc.). In other words, it is simply concerned with what Locke (1988: 105) calls the '*internal Operations of our Minds*'. As a consequence, they become the 'Objects' of reflection, whereas the objects of sensations are, as we have just seen, the very '*external, sensible Objects*' themselves that we have perceived via our senses.

The next and final thing to say about Locke's notion of ideas, is that they are the 'materials' or building blocks of human knowledge. For Locke, all human knowledge is constructed out of the ideas of things that have been acquired via both the primary source of sensation itself and the secondary source of reflection. Thus, for Locke, there can be no 'innate ideas'. The human mind is at birth, for Locke (1988: 104), a 'piece of white paper', i.e., a *tabula rasa* (a blank slate). Consequently, it is devoid of any ideas.

1.2 Locke's distinction between real and nominal essences

I shall now discuss Locke's all-important distinction between real and nominal essences, by first articulating Locke's general conception of the distinction he draws between real and nominal essences, which will allow me to bring out its basic elements. I begin with the very notion of essence itself.

According to Locke (1988: 417), the 'original proper signification of the Word' essence, and the 'sense' in which 'it is still used, when we speak of the *Essence* of particular things', is that it 'may be taken for the very being of any thing, whereby it is, what it is'. In other words, whatever something is, will depend on what makes it essentially be the thing that it is. For example, for any piece of matter (or 'Substance') to be essentially what it is – something which has all the 'discoverable Qualities' that we associate with it – then it will have to be the product (or the result) of whatever it is that makes it what it is; in this particular case, it is for Locke (1988: 417) its 'real internal... Constitution...' which makes it what it is. Hence the essence of something (or anything for that matter) is whatever makes it be fundamentally what it is. Another way of putting this, is to say that something cannot be what it is without being what it fundamentally is in terms of its essence; that is, if it lacks the essence in question then it will not be what it is. So, if a piece of matter – or a particular 'Substance' – lacks the specific essence in question, then it will not be that particular thing.

Given this particular notion of essence, the following point can be discerned from it: it would seem that the notion of essence is above all concerned with specifying the fundamental causal foundation of things which makes them be what they are.

Now, it is in terms of this notion of essence that Locke draws his specific distinction between the real and nominal essence of things in general.

To start with, Locke's (1988: 418) distinction between real and nominal essence is primarily between, on the one hand, 'the very *Essentia,* or Being, [i.e., the essence] of the thing itself, that Foundation from which all its Properties flow, and to which they are all inseparably annexed', and, on the other, 'the discoverable Qualities' or 'Properties' themselves which have consequently flowed from and are 'inseparably annexed to' such a 'Foundation'. In other words, the distinction is above all between the fundamental causal foundation of things and their qualitative features which are necessarily linked to and derived from it.

Although this is how Locke conceptualises his general distinction between the real and nominal essence of things, it is worth stressing what type of distinction he is actually drawing here. Locke is above all drawing an ontological distinction to identify the actual make-up of things, which also includes a causal relation at the same time. Locke says that things are generally comprised of both a real and nominal essence. They are made up of not only that which constitutes their causal foundational aspects (real essences) but also their qualitative features (nominal essences). And it is also causal in the sense that the constitutional or foundational aspects of things (real essences) causally determine or give rise to their sensible features (nominal essences).

I shall now present Locke's 'corpuscularian' conception of it, as it applies to the material phenomena of the natural world. As we shall see, it is largely a particular development of his general conception of the distinction.

It has been important to point out that Locke has, to begin with, a general conception of the real and nominal essence distinction. For it should not be immediately assumed that Locke's 'corpuscularian' conception of the distinction is, at the same time, his actual conception of what he means by the distinction between the two types of essences. All one can reasonably say is that it is, as I am about to show, his particular construal of it, as it applies in a concrete way to the actual phenomena of the natural world. For, if we were to consider the general distinction between the two types of essences, as it applies to his discussion of the names of mixed modes and relations, then what would be found is that it is not, and nor could it possibly be, construed in 'corpuscularian' terms *simply because* the names of mixed modes and relations do not, unlike their counterparts in terms of the names of substances, signify anything which is deemed to be a part of the natural world – a world in which things are held to be the products of the 'corpuscular arrangements' of things. (On this point, see both Atherton 2007 and Ayers 1981.)

To begin with, I shall sketch out the 'corpuscularian Hypothesis' which informs Locke's conception of the distinction between the real and nominal essence of things in the natural world. According to the corpuscular hypothesis of matter of Locke's time, all pieces of matter – whether of an organic or inorganic variety – consisted of what were known as 'corpuscles'. These corpuscles were nothing more than the basic but unobservable minute particles out of which all pieces of matter were made. Given this, it was hypothesised that the different qualities or properties of things were produced as a direct result of the various interactions between and

subsequent arrangements of these corpuscles. For instance, the hardness, shininess, yellowness and heaviness of a piece of gold were due to the specific interactions and arrangements of its corpuscles – in short, its corpuscular structure. As a consequence, these hypothesised corpuscles were deemed as the unobservable causal factors behind how different things would manifest their observable features.

A chief proponent of the corpuscular hypothesis of matter was, as Boas Hall (1981: 412-524) points out, the chemist Robert Boyle, who, more than any other natural scientist of the time, championed its development as a viable scientific theory over its alternatives, especially the ones thrown up by the alchemists. As we shall see in the next chapter, Locke's own 'corpuscularian' ideas are based on Boyle, as well as Newton.

Given Locke's general conception of the distinction between the real and nominal essence of things, it is possible to construe the unobservable corpuscular structure of things as being their real essence component and the different observable qualities or properties of things, which they give rise to, as being their nominal essence component. For, as we have already seen, the distinction between the real and nominal essence of things is basically between their causal foundational aspects and their manifested features. And this is what, as has just been shown, the unobservable corpuscular structure of things and their observable qualities or properties capture in a parallel way.

It is thus in terms of this very hypothesis of the corpuscular nature of matter that Locke conceptualises his distinction between the real and nominal essence of things, as it applies to the material phenomena of the natural world. This is evident in the following formulation of it, wherein Locke (1988: 418) distinguishes between, on the one hand, the 'real … Constitution' of the 'insensible Parts' of 'all natural Things', from which 'flow' their 'sensible Qualities', and, on the other, the very 'sensible Qualities' themselves which both consequently and necessarily 'flow' from their 'real … Constitution' of 'insensible Parts'. In short, the distinction between the real and nominal essence of all natural things is simply between their insensible parts and their sensible qualities. Thus, Locke's distinction between the real and nominal essence of things, as it applies to the material phenomena of the natural world, is couched in terms of the best available scientific hypothesis of his time: the 'corpuscularian Hypothesis'.

According to Locke (1988: 547), despite some reservations on his own part, the 'corpuscularian Hypothesis' went the 'farthest in an intelligible Explication of the Qualities of Bodies'.

However, this view of the corpuscularian Hypothesis being the best available one of the time is disputed by Chalmers (2009), as we shall see in the next chapter.

1.3 Locke's classificatory account of the names of natural substances

I shall now discuss Locke's views that only nominal essences but not real essences are all that we know through our senses on the basis of his empiricism (as evinced primarily in his account of the names of substances). Since all 'ideas' are based on our sensory experiences, we can have no 'ideas' of real essences in the sense that we can have of nominal essences, that is, we cannot have any sensory ideas of them (in short, 'ideas of sensation').

1.3.1 Locke's overall thesis

In his account of the names of substances, Locke asks two questions:

1. Do the names of substances refer to real or nominal essences?
2. What do they actually signify – is it real or nominal sorts of things in nature (i.e. natural or artificial kinds)?

Locke's account of the names of substances seeks to establish two theses. Locke's first thesis, which is his overall answer to the question about how the names of substances are made (i.e., in terms of real or nominal essences), is as follows: it is Locke's (1988: 418) view that, while it is true that 'all natural Things … have a real, but unknown Constitution of their insensible Parts [hence their real essence component], from which flow those sensible Qualities [hence their nominal essence component], which serve us to distinguish them one from another, according as we have Occasion to rank them into sorts, under common Denominations', it is nevertheless the case that we shall have to 'content ourselves with such *Essences* of the Sorts or Species of Things, as come within the reach of our Knowledge: which, when seriously considered, will be found … to be nothing else, but those abstract complex *Ideas*, to which we have annexed distinct general Names'. In other words, it is in terms of their nominal, and not real, essences that the names of substances are made, for it is these, according to Locke, which are both *immediately* and *only* signified by the abstract ideas of different sorts or kinds of things.

Locke's second thesis, which is his overall answer to the question about what the names of substances consequently signify, is as follows: for Locke, as a consequence of this way of classifying and naming different sorts or kinds of things, they necessarily come to signify

nominal rather than real sorts or kinds of things in nature (in short, artificial rather than natural kinds).

In sum, then, Locke's overall thesis is this: *the names of substances are made via nominal essences and as a result they signify nominal sorts or kinds in nature (i.e., artificial ones)*.

1.3.2 Locke's three theses

Notwithstanding what Locke himself tries to establish in his account of the names of substances, I shall nonetheless show that there are in fact three different theses offered by him. They are:

1. Locke's primary thesis: things are sorted into kinds via nominal, and not real, essences – hence the names of substances signify nominal, and not real, kinds in nature.
2. Locke's secondary thesis: there is nothing essential to anything except in relation to 'abstract ideas' – hence the names of substances signify arbitrary or artificial kinds in nature.
3. Locke's alternative thesis: the 'boundaries' of sorts or kinds are knowable – hence the names of substances signify real kinds in nature.

1.3.3 Locke's theory of general terms as predicated on his theory of ideas

According to Locke, words in general stand for or signify the internal conceptions of someone's mind. However, if the goal of a language is to use words in order to communicate with one another about real things which exist in the natural world, then the words one uses must subsequently stand for or signify, as Locke says, the actual or specific ideas of things (e.g., words like 'gold' must actually refer to something that is in fact gold, in some way). In other words, they must refer to the ideas of things that have ultimately originated in experience via the primary source of sensation (i.e., via the means of sense perceptions). For if, they do not, they will not stand for or signify anything that, in Locke's view, actually exists.

So, what words in general stand for or signify is dependent upon those ideas of things which have been ultimately derived from experience *via* our sense perceptions of them (i.e., via the principal source of sensation).

There are two points regarding Locke's account of general terms: (1) general terms (or words) are made via the process of abstraction, which in turn results in the creation of 'abstract ideas';

and (2) general terms, whether they be instances of the names of mixed modes and relations or the names of substances, nonetheless stand for or signify what Locke (1988: 404) calls the 'Sorts and Kinds, or ... *the Species and Genera of Things*'.

So, how are general words made? Locke's (1988: 410-11) answer is:

> Words become general, by being made the signs of general *Ideas*: and *Ideas* become general, by separating from them the circumstances of Time, and Place, and any other *Ideas*, that may determine them to this or that particular Existence. By this way of abstraction they are made capable of representing more Individuals than one; each of which, having in it a conformity to that abstract *Idea* ...

In short, it is via the process of abstraction that general words are made; that is, the process of essentially leaving out what is specific in terms of the ideas to something and selecting what are common in terms of the ideas found within a group of things (e.g. '*Man*').

Thus, the basic point here is that 'nothing new' is made; rather, all one has done is to 'leave out of the complex *Idea*' of particular things 'that which is peculiar to each, and retain only what is common to them all' (Locke 1988: 410-11). Furthermore, it shows how the 'complex abstract ideas' by which things are designated or identified are, above all, created as a result of this particular process.

Given this, what do general words consequently stand for or signify within Locke's theory of general terms? For Locke (1988: 414), they stand for or signify what he calls the 'Sorts and Kinds, or ... *the Species and Genera of Things*'.

As a consequence, general words (or terms) come to stand for or signify sorts or kinds of things because they are nothing but expressions (or signs) of the abstract ideas by which several things are found to have something in common with each other and as a result are identified as being members of the same sort or kind.

1.3.4 Locke's primary thesis

In order to present Locke's (1988: 439) primary thesis, let us start with the following passage of his, wherein he articulates how the natural substances of the world are both sorted and named:

> The measure and boundary of each Sort, or *Species*, whereby it is constituted that particular Sort, and distinguished from others, is that we call its *Essence*, which *is*

> nothing but that *abstract* Idea *to which the Name is annexed* … This, though it be all the *Essence* of natural substances, that we know, or by which we distinguish them into Sorts; yet I call it by a peculiar name, the *nominal Essence*, to distinguish it from that real Constitution of Substances, upon which depends this *nominal Essence*, and all the Properties of that Sort; which … may be called the *real Essence* …

Given what Locke says here in this passage, it is clearly his view that the sorting and naming of the natural substances of the world is done on the basis of their nominal essences, i.e., the abstract ideas that we have of them (which, in turn, are nothing else but the signs of the common features of things). The principal reason for this is, as Locke says, they are all that we know in terms of the two types of essences that he distinguishes here. Consequently, real essences – even though they are the source behind the nominal essences by which natural substances are sorted and named – play no *classificatory* role in how various things in the natural world are both sorted and named.

Now, Locke (1988: 443) presents two main arguments for this thesis. The first one is:

> That we find many of the Individuals that are ranked into one Sort, called by one common Name, and so received as being of one *Species*, have yet Qualities depending on their real Constitutions, as far different from one another, as from others, from which they are accounted to differ *specifically*.

The evidence for this claim is given by the example of the empirical work of the 'wary Chymists' of Locke's (1988: 443) time, who:

> are often, by sad Experience, convinced of it, when they, sometimes in vain, seek for the same Qualities in one parcel of Sulphur, Antinomy, or Vitriol, which they have found in others.

What Locke is claiming here, as Kornblith (1993) points out, is that, in spite of the best efforts of 'wary Chymists' to establish that several individual things, or pieces of a particular so-called species of a natural substance, exhibit the same qualities – which would subsequently indicate that they all have the same 'real Constitution' in common – it nonetheless turns out that they display other qualities, which suggest that they are perhaps (or probably) different from each other in terms of their purported 'real Constitutions'. Consequently, these individual things cannot really belong to the same species of a natural substance in terms of some so-called real

essence that they presumably have in common with each other. Furthermore, it cannot be said that they are made up of the same common features of which the abstract ideas are meant to be a sign of (hence their nominal essences). Therefore, it cannot be the case that we rank, sort and name natural substances according to their purported real essences. For if we did, then 'it would be impossible to find different Properties in any two individual substances of the same *Species*', as it would be 'to find different Properties in two Circles, or two equilateral Triangles' (Locke 1988: 443). Thus, as far as Locke is concerned, we have no choice but to rank, sort and name natural substances according to their nominal essences, which are nothing but the abstract ideas by which the common features in terms of the sensible qualities of similar things are first recognised or identify by.

The other main argument is:

> Nor indeed *can we* rank, and *sort Things*, and consequently … denominate them *by their real Essences*, because we know them not.
>
> (Locke 1988: 444)

For, as Locke (1988: 444) says:

> Our Faculties carry us no farther towards the knowledge and distinction of Substances, than a Collection of those sensible *Ideas*, which we observe in them ...

Our inability to do so, i.e., to sort, rank and name things according to their real essences, because we lack the requisite faculties, is, as Locke (1988: 444) says, analogous to the efforts of a 'blind man'. Just like a person who lacks the faculty of sight and consequently cannot see any of the sensible qualities of things (such as their colours), so do we lack the requisite faculties which would presumably allow us to know the real essences of things, i.e., their insensible parts. Therefore, in neither situation can any ideas about things be acquired. Because of this, it is consequently impossible, in the specific case of the names of substances, to sort, rank and name things according to their real essences – in short, in terms of something of which there are no ideas.

To appreciate the point that Locke is making here, let us elaborate on it *via* his theory of ideas. According to this theory of Locke's, it is his central contention that all our ideas of things are acquired ultimately from experience via the primary source of sensation. In doing so, what we come to have ideas of are the sensible qualities of external objects. Significantly, for Locke,

this is the only means by which we can come to have 'ideas'; and moreover, these are the only types of things about which we can have 'ideas'.

So, for Locke, in order for us to have any ideas of the real essences of the names of substances, we would need to be able to perceive them via our principal source of sensation (sense perception). However, we are unable to do this because, according to Locke's corpuscularian conception of the distinction he draws between real and nominal essences, real essences are the insensible parts of matter. Because of this, they are unperceivable via the primary source of sensation. As a consequence, we can have no 'ideas' of them. Of course, this stands in stark contrast to nominal essences, which are perceivable – as they are the sensible qualities of things. It is because they are the sensible qualities of things that they can consequently be perceived via the primary source of sensation – which means therefore, unlike the real essences of things, we can have 'ideas' of them. Thus, unlike nominal essences, we cannot have any direct sensory ideas of the real essences of substances.

The upshot for Locke is that real essences, because we can have no ideas about them in the way that we can have of nominal essences, are unknown. At this point it should be noted that Kornblith (1993: 23-25), for example, interprets Locke as saying they are unknowable, but this cannot be right given what I have just shown. Nevertheless, since they are *unknown*, they can play no *classificatory* role in the sorting, ranking and naming of the natural substances of the world. Therefore, we have no choice but to do so in terms of what we *do*, and it would seem *can* readily, know: *nominal essences*. Thus the names of substances are solely and only made on the basis of knowledge of nominal essences.

Given that the names of substances are made based on nominal essences and not real essences, it consequently follows that the names of substances can signify nothing else but nominal sorts or kinds of things in nature. They can only signify that sort or kind of thing in nature which is based on knowledge of nominal essences. For instance, the word *gold* (which is an example of a name of a substance) can only signify that sort or kind of thing in nature which is based on the following sensible qualities that make up its nominal essence – such as being 'a Body yellow, of a certain weight, malleable, fusible, and fixed' (Locke 1988: 439); as a consequence, anything which exhibits these sensible qualities will be classified as that sort or kind of thing in nature which is designated by the word *gold*. However, what the names of substances cannot do is signify anything in terms of the purported real essences of things – which is to say that

the names of substances cannot signify what may be called real sorts or kinds of things in nature.

In sum, Locke's primary thesis is that: *things are sorted into kinds via nominal, and not real, essences and, as a consequence, the names of substances stand for or signify nominal, and not real, kinds of things in nature (i.e.,* artificial *rather than* natural *kinds).* As might be noted here, this primary thesis of Locke's coincides with his overall thesis in his account of the names of substances. However, as I am about to show, Locke has other theses that are not necessarily consistent with his primary/overall thesis. Moreover, as we have seen, it is not only based on Locke's theory of ideas, it is also consistent with his theory of general terms (which is predicated on his theory of ideas).

1.3.5 Locke's secondary thesis

Locke develops the following thesis: *there is nothing essential to anything except in relation to the very abstract ideas by which things are both sorted and ranked under different names of substances, and as a result, the names of substances cannot signify anything but arbitrary sorts or kinds in nature, i.e., inventions of the human mind*. Locke (1988: 416) often refers to these inventions of the human mind as '*the Workmanship of the Understanding*'. Hence, as I shall explain, this is properly speaking a relativist or conventionalist thesis that Locke is putting forth here.

Locke (1988: 416) first says that if we:

> take but away the abstract *Ideas*, by which we sort Individuals, and rank them under common Names, and then the thought of any thing *essential* to any of them, instantly vanishes ...

That is, there can be no notion of what is essential to anything except in relation to the abstract ideas by which we sort and rank different individual things under the various common names of substances. For it is in terms of abstract ideas that things are deemed to have any essential features to them. This means, therefore, that the notion of anything essential to any individual thing is, for Locke, solely dependent on whatever comprises the abstract ideas by which different individual things are both sorted and ranked under the various common names of substances. Hence for Locke (1988: 416), there can be 'no notion of the one, without the other', which 'plainly shews their relation' is one of verbal necessity rather than, say, some type of physical or natural necessity.

Locke's (1988: 416) next point is there is nothing 'essential to me' or anything else. As a result, it is not the case that one must necessarily possess and/or retain any of these so-called essential features or qualities which an individual person (such as Locke himself) is either initially born with or possesses; nor, for that matter, that anything else cannot possess some of the same features found in other things. The simple reason being that everything is, as these examples of Locke's illustrate, *contingently* dependent on both nature itself and whatever else may happen to them throughout their existence. Consequently, there are no compelling reasons, as provided by nature itself, for why something should, out of some type of necessity, either be or always be what it is. Thus, for Locke, nature is simply ruled out as providing any sound basis for claiming that this or that thing must necessarily possess this or that so-called essential feature or quality.

So, for Locke (1988: 416): 'None of these are essential to the one, or the other, or to any Individual whatsoever', except until 'the Mind refers it to some Sort or *Species* of things', and furthermore, does so in accordance with 'the abstract *Idea* of that sort' – whereupon 'something is found *essential*'. In other words, it is only in *reference* to the actual conceptions of the human mind, as based upon the abstract ideas by which different sorts of things are constructed or formulated, that anything is deemed to possess or exhibit something that is essential to it. Thus, for Locke, it is only in terms of the conceptual activities or practices of human beings rather than anything else which is external to them, like nature, that this occurs (Kornblith 1993: 46).

To sum up, then, it is Locke's basic thesis here that there is nothing essential to anything except in relation to what the names of substances signify: the abstract ideas by which different sorts or kinds of things in nature are made. Moreover, it is Locke's view that it is the conceptual activities or practices of human beings, rather than nature itself, which actually determines not only what constitutes the 'essences' of different sorts or kinds of things but also whether or not an individual thing possesses anything essential to it.

Let us now consider what sorts or kinds of things the names of substances can, as a result of it, actually signify. As we shall see, what they actually signify are nothing but arbitrary kinds in nature – which means, therefore, they are nothing else but the inventions or creations of the human mind.

Two things need noting here. Firstly, it is, for instance, Ayers' (1981 and 1991) view that, given Locke's overall account of the names of substances, the names of substances consequently signify nothing else but arbitrarily constructed kinds on the part of the human beings. Now, I

think this is true but only up to a point. For, as I shall show via Kornblith's (1993) work, the names of substances need not signify such arbitrary kinds; indeed, they can actually come to signify, as illustrated in the work of 'wary Chymists', the existence of real kinds in nature at least in terms of their 'boundaries', though never, admittedly, in terms of their underlying real essences. This crucial point of Kornblith's will be discussed when I come to present Locke's alternative thesis. Secondly, Kornblith (1993: 21-23) refers to this as a conventionalist thesis, wherein the names of substances stand for those sorts or kinds of things in nature which reflect nothing else but the interests of those who devise such conceptual categories. Another way of putting it is to say that such a conceptual practice as this one is indicative of a *relativist* approach to how our conceptual categories are constructed. As such, it may also be known as a relativist thesis that Locke is consequently espousing here. This is, for instance, the view of Woolhouse (1971: 102-111).

To do this, let us first examine the following statement of Locke's (1988: 441):

> if the *Idea* of *Body*, with some People, be bare Extension, or Space, then Solidity is not *essential* to Body: If others make the *Idea*, to which they give the name *Body*, to be Solidity and Extension, then Solidity is essential to *Body*. That therefore, and *that alone is* considered as *essential*, which *makes a part of the complex* Idea *the name of a Sort stands for*, without which no particular Thing can be reckoned of that Sort, nor be intituled to that name ...

There are thus competing and/or various ways of determining how something is to be both sorted and ranked under a particular name of a substance. This all depends on what actually makes up the specific abstract idea which is signified by the name of the substance. So, if the name of the substance, such as in the case of 'Body' here, signifies that sort of thing which is both an extended and solid substance, then, it necessarily follows, that nothing can be both sorted and ranked under the name 'Body' unless it possesses or exhibits the very qualities of being something that is both extended in space and solid in bulk. Similarly, if the word 'Body' merely signifies, in terms of its abstract idea, something that is an extended substance in space, then it equally follows that nothing can be sorted and ranked under the name 'Body' which does not possess the specific quality of extension. In each case, then, things are both sorted and ranked in accordance with whatever comprises the precise abstract idea which is signified by the specific name of the substance: 'Body'.

Thus, for Locke, there is no one settled or proven way in which things are both sorted and ranked under the names of substances. There is more than one way of both sorting and ranking something that is presumably an instance of being a *Body*. This means, therefore, that how things are both sorted and ranked under the names of substances *is relative to* the actual conceptions that human beings have formed about different sorts of things.

Now, the significance of all this is that there is no right or wrong way regarding what the names of substances must necessarily signify in terms of the abstract ideas of 'Sorts'; there are only different ways, which in turn must follow their own stipulations. Let us elaborate on this by first dealing with the second part of this point. If, for instance, the term 'gold' signifies that sort of thing in nature which is a hard, heavy but malleable and fusible piece of golden-coloured metal (hence, the composition of its abstract idea), then that is what gold *is* to anyone who is familiar with the name of that particular substance. Consequently, if this is what the name 'gold' actually signifies, in terms of its abstract idea, then nothing can be counted as an instance or sample of gold if it does not match up with this specific abstract idea which the name 'gold' signifies. In other words, if substance *A* is made up of the qualities of *x*, *y* and *z*, which in turn is signified by the name 'gold', then, in order for anything to be an instance of substance *A*, and so be called gold, it will need to exhibit or possess the same qualities of *x*, *y* and *z* – otherwise, it will not be called gold. So, once the abstract idea, which is signified by the name of a substance, is established, it will consequently stipulate what something must be in order for it to be designated by a certain name, such as 'gold'. It is only under these conditions, then, that some particular instance of a substance is either rightly or wrongly sorted under a certain name. However, while this may be the case, it is not so with respect to the first part of this point. For the very reason that has been given in the above thesis of Locke's – that there is nothing in nature which compels anyone to say that this or that feature of some individual thing must necessarily be included in the abstract idea of some sort of thing, which is then given a particular name in order to denominate it from other sorts of things in nature. As a result, there are, under these conditions, no right or wrong way by which things are initially sorted and ranked in terms of certain names of substances.

However, this is not to say that anything goes in terms of what the names of substances signify with respect to different sorts or kinds of things in nature. For, whatever makes up the abstract ideas of 'Sorts', which are signified by their specific name of a substance, must nonetheless bear a direct relation with the features or qualities that are presumably possessed by that particular sort or kind of thing in nature. The principal reason for saying this is provided by

what Locke's whole account of the names of substances is predicated on: his theory of ideas. Locke says that there can be no ideas of things unless these things actually possess features which these ideas can consequently be signs of. Given this, if it is claimed that some sort of thing, such as gold, is a hard, heavy but malleable and fusible piece of golden-coloured metal, then this is what the abstract idea must be a sign of. In other words, it cannot stand for those features which a particular sort of thing lacks. There has to be, according to Locke, an immediate and direct correspondence between our 'abstract ideas' of sorts and what features or qualities these sorts of things actually (and literally) possess. Otherwise, the alleged abstract idea does not actually stand for (or, is a sign of) any recognisable sort or kind of thing in nature, which in turn can be given a specific name.

Given all this, the names of substances consequently come to signify nothing else but arbitrarily constructed sorts or kinds of things in nature, albeit, in the ways just specified. In short, they are simply the inventions or creations of the human mind, rather than the products of nature itself.

To sum up, then, it is Locke's overall thesis here that *there is nothing essential to anything except in relation to the very abstract ideas by which things are both sorted and ranked under different names of substances, and as a result, the names of substances cannot signify anything but arbitrary sorts or kinds in nature, i.e., inventions of the human mind*. This is, properly speaking, a relativist or conventionalist thesis, since the names of substances are made in terms of the conceptual activities of human beings. In other words, given that there is nothing essential to anything then it is up to human beings to decide, on whatever basis that is, whether something possesses the essential features which will consequently allow it to be both sorted and ranked in accordance with the specific abstract idea that is signified by the particular name of a certain natural substance.

1.3.6 Locke's alternative thesis: first part

Locke's primary thesis, however, presumes the actual existence of 'natural kinds', i.e., real sorts or kinds of things in nature. Take the following statement, which best of all sums up Locke's (1988: 439) primary thesis:

> The measure and boundary of each Sort, or *Species*, whereby it is constituted that particular Sort, and distinguished from others, is that we call its *Essence* ... This, though it be all the *Essence* of natural substances, that we know, or by which we distinguish them into Sorts; yet I call it by a peculiar name, the *nominal Essence*,

> to distinguish it from that real Constitution of Substances, upon which depends this *nominal Essence*, and all the Properties of that Sort; which … may be called the *real Essence*: *v.g.* the *nominal essence* of *Gold*, is that complex *Idea* the word *Gold* stands for, let it be, for instance, a Body yellow, of a certain weight, malleable, fusible, and fixed. But the *real Essence* is the constitution of the insensible parts of that Body, on which those Qualities, and all the other Properties of *Gold* depend.

As can be seen here, it is Locke's view that the sorting and ranking of things under different names of substances is done in terms of nominal rather than real essences. However, as Kornblith (1994: 24) says, Locke also points out that the specific composition of the nominal essence, by which things are distinguished into different sorts, is nonetheless dependent on the actual constitution of the real essence of various sorts or kinds of things in nature. This point is well illustrated by Locke in terms of his paradigmatic example of a natural substance: gold. For what is being revealed here by him is that the various qualities and/or properties of that sort of substance known as gold are directly dependent on or causally derived from the peculiar constitution of the 'insensible parts' which comprise each individual instance of it. In short, the actual nominal essence of gold is solely based on whatever comprises its real essence.

What is subsequently interesting about this point concerning the causal relation that holds between the nominal and real essence of different sorts or kinds of natural substances is that it raises, in principle, the following possibility. If it were possible to know the real essences of natural substances, i.e., their 'real constitution of insensible parts', then one would be in a position to consequently classify things in accordance with them. In so doing, one would be classifying things into real sorts or kinds in nature (which would mean, therefore, that one would be, as Kornblith (1993) says, carving nature at the joints). As a result, the names of substances would in fact stand for or signify real sorts or kinds of things in nature, i.e., 'natural kinds'. In addition, we would also see how the specific nominal essences of the different sorts of natural substances are actually and directly generated by their real essences. Thus, it would be possible to make the nominal essences of different sorts of natural substances match up with their real essences; in other words, there would in many cases be a direct correspondence between the two types of essences which comprise any natural species of things.

Of course, this is all predicated on the existence of there being real essences that determine the make-up of the nominal essences, by which things are both sorted and ranked under various names of substances. Since, according to Locke, there are in fact real essences, then it follows

that there must be, in principle, real sorts or kinds of things in nature as well, i.e., 'natural kinds'.

Given this, it is in this sense that Locke's primary thesis *presumes* the actual existence of 'natural kinds'. In doing so, Locke is implicitly committing himself to the *metaphysical view* that the world is comprised of real sorts or kinds of things in nature ('natural kinds'), regardless of whether we can really know anything about them.

1.3.7 Locke's alternative thesis: second part

To begin with, I shall just clarify what has been established about Locke's primary thesis. Basically, what has been established is this: *on the one hand*, things are both sorted and ranked into different kinds in nature via nominal, and not real, essences, while, *on the other*, real sorts or kinds of things in nature (i.e., 'natural kinds') are presumed to exist. The upshot of such a thesis is this: while it is presumed that 'natural kinds' exist, it is not possible, however, to know *either* the real essence by which things are actually sorted in nature *or* where the precise 'boundaries' of the 'Sorts' in nature lie. Hence, this thesis of Locke's is consequently a sceptical one in that it clearly denies we can know anything about them in these terms, i.e., in terms of *both* their underlying, essential natures *and* their boundaries. This way of putting it basically coincides with Kornblith's description and/or summary of what he calls Locke's 'official view': the 'view ... which rejects the possibility of knowledge of real essence itself as well as knowledge of the boundaries of real kinds' (1993: 29; see also: 16-17 and 23-25).

This thesis is developed out of his first one (his primary thesis) on the implicit assumption that there are real sorts or kinds of things in nature (i.e., natural kinds) which, though they cannot be known at the level of real essences, can nonetheless be known at the level of nominal essences. This is an epistemological thesis.

It is possible, given what else Locke says in his account of the names of substances, to at least know where the 'boundaries' of these real sorts or kinds of things in nature exist. Therefore, as Kornblith (1993) points out, it is possible to deduce a less sceptical view on Locke's part concerning what we can actually know about real sorts or kinds of things in nature.

In order to show this, let us initially examine the following (lengthy) passage of Locke's (1988: 443):

> that the *Species of Things to us, are nothing but the ranking them under distinct Names, according to the complex* Ideas *in us*; and not according to precise, distinct,

> real *Essences* in them, is plain from hence; That we find many of the Individuals that are ranked into one Sort, called by one common Name, and so received as being of one *Species*, have yet Qualities depending on their real Constitutions, as far different from one another, as from others, from which they are accounted to differ *specifically*. This, as it is easy to be observed by all, who have to do with natural Bodies; so Chymists especially are often, by sad Experience, convinced of it, when they, sometimes in vain, seek for the same Qualities in one parcel of Sulphur, Antinomy, or Vitriol, which they have found in others. For though they are Bodies of the same *Species*, having the same nominal *Essence*, under the same Name; yet they do often, upon severe ways of examination, betray Qualities so different one from another, as to frustrate the Expectation and Labour of very wary Chymists. But if Things were distinguished into *Species*, according to their real Essences, it would be ... impossible to find different Properties in any two individual Substances of the same *Species* ...

This passage, as can be seen, is meant to illustrate that things are both sorted and ranked under the specific names of substances in accordance with the abstract ideas that we have about them rather than in terms of any real essences. In short, it is meant to show that we do this in terms of nominal essences. However, it is also a passage which shows other things, contrary to Locke's own expressed intentions here.

To start with, this passage also shows that we can at least know that despite the fact that things are initially sorted together under the common name of a substance via our abstract ideas (i.e., nominal essences), they may nevertheless exhibit observable features which, on closer inspection, reveals that they ought not to be grouped together under the same common name of a substance. This point can be demonstrated as follows. If, for example, as Kornblith (1993: 27) suggests, we come across two pieces of rock, whereupon it is observed that one is malleable and one is not, then it immediately follows that neither of them can belong to the same species of rock. Instead, they must each belong to some other species of rock. As a result, while we may not know what makes either of them different from each other, i.e., at the level of real essences, what we do know, however, is that they are clearly different from one another in terms of their salient features, i.e., at the level of nominal essences. Given this, it can be inferred that, in all likelihood, they each belong to some other sort or kind of thing in nature, i.e., to different species of rocks. The significance of this example, then, is that it highlights that not only are there real sorts or kinds of things in nature (i.e., 'natural kinds'), but we can also know

when something does not belong with other things on the basis of differences in their salient features (i.e., in terms of their nominal essence).

Admittedly, this example does not, in itself, establish anything else about these real sorts or kinds of things in nature, particularly in terms of what makes something be a member of one sort of thing in nature as opposed to another. Indeed, one is still pretty ignorant about all this. Kornblith (1993: 27), for instance, is aware of this problem: 'This is not a great deal of knowledge, but it is considerably more than is allowed on the official view' (i.e., what I call Locke's primary thesis). As a result, one may still have no option but to arbitrarily base the names of substances on nothing else than the inventions or creations of the human mind, as advocated by Locke in (especially) his secondary thesis. This is, incidentally, the type of inference that Ayers (1981 and 1991) draws in his own discussions of Locke's account of the names of substances. As we shall soon see, Locke does nonetheless provide examples which ultimately demonstrate that this need not be the case.

In addition to this first point, this passage of Locke's also shows, as Kornblith (1993) points out, that the work of the 'wary Chymists' themselves not only reveal that they have certain expectations about what they are presumably doing when examining different samples of natural substances but are also frustrated in the process of trying to do it. That is to say, it is their 'Expectation' that whenever they examine, say, different instances of 'Sulphur, Antinomy, or Vitriol', that they will always disclose the same set of properties as they have found in other examples of them, and in so doing, confirming that the names of these different sorts of natural substances stand for the same nominal essences. Furthermore, they do this on the assumption that the nominal essences of each of these specific samples of a sort of natural substance share a common, underlying real essence which binds them altogether into a specific sort or kind of thing in nature. Yet, despite this type of 'Expectation' on their part, these 'wary Chymists' are nonetheless 'frustrate[d]' when this does not happen, i.e., whenever they find after 'severe ways of examination' that these different samples of a particular sort of natural substance subsequently 'betray Qualities' which are so 'different' from 'one ... another' that they cannot be grouped together under the same name of a particular sort of natural substance. Indeed, they are ultimately frustrated because their various terms, which are meant to stand for different sorts of natural substances, fail, via the *route* of their nominal essences, to help pick out a real sort or kind of thing in nature. Hence, as Kornblith (1993) points out, this is the true source of their frustration with what they are attempting to do within the classificatory side of chemistry.

So, what has so far been revealed here by this passage of Locke's is that not only are there real sorts or kinds of things in nature but that the very work of the 'wary Chymists' themselves also presupposes their existence despite the fact that they are seemingly unable to pick them out via the nominal essences of their terms.

It might appear then that there is nothing else being revealed, or even could be revealed, here by this passage of Locke's, which would indicate that it is, say, possible to still know a lot more about the different sorts or kinds of things in nature (i.e., 'natural kinds') rather than presuming nothing more than their mere existence. This is, for instance, the view of Ayers (1981). However, as I am now about to show, there is something else to be revealed here: that it is in fact possible to at least know, as Kornblith (1993) claims, the boundaries of real 'Sorts' in nature on the basis of the exemplary work of 'wary Chymists'.

First, the exemplary work of 'wary Chymists' is nothing more than their 'severe ways of examination', i.e., the methods which eventually lead them to reveal that, for instance, two samples of a particular sort of natural substance do not share the 'same Qualities', despite the fact that they are initially grouped together under the same name of a substance, which in turn is meant to signify a similar nominal essence. Now, it is via this method that 'wary Chymists' are able to identify the boundaries of real 'Sorts' in nature.

To demonstrate this, let us consider the following scenario, wherein Locke's 'wary Chymists' are confronted by the problem of what to do when, as a result of their 'severe ways of examination', several samples of, say, 'Sulphur' are revealed as having different 'Qualities', which in turn means (presumably) that they do not share the same nominal essence as signified by the name of that particular sort of natural substance – and furthermore, do not indicate the same real 'Sort' in nature. Well, the most obvious and rational response, as Kornblith (1993: 28) suggests, would be that they would re-examine, in 'severe ways', these various purported samples of sulphur in order to see what it is that they actually have in common with each other, if anything at all. If, as a consequence, it is discovered that they do *in fact* share certain 'Qualities', i.e., ones which are always invariably found together in them, then it would make sense to revise the ideas which make up the nominal essence of this particular sort of thing in nature so its specific name, 'Sulphur', signifies it more precisely and accurately. In doing so, this would allow these 'wary Chymists' to use this revised conception of the nominal essence, which is signified by this particular name of a natural substance, 'Sulphur', to help pick out more clearly what is and what is not an actual instance of it.

Accordingly, as these 'wary Chymists' continue to use, as Kornblith (1993) points out, this particular method of examination, which means they will continue to revise the ideas which make up the nominal essence of these different sorts of natural substances, they will consequently get the common names of these various sorts of natural substances to match up more and more with, at the very least, the boundaries of the real 'Sorts' in nature. In other words, via the *route* of nominal essences, which have been constructed in a more precise way, it is possible to know what constitutes the boundaries which distinguish one real 'Sort' in nature from another.

Admittedly, this is not easy to do, as Locke (1988: 457) points out elsewhere in his account of the names of substances:

> ... yet *Men are far enough from having agreed on the precise number of simple* Ideas, or Qualities, *belonging to any sort of Things, signified by its name*. Nor is it a wonder, since it requires much time, pains, and skill, strict enquiry, and long examination, to find out what, and how many those simple *Ideas* are constantly and inseparably united in Nature, and are always to be found together in the same Subject.

However, if one does engage in such rigorous work, as epitomised in the case of 'wary Chymists', that 'requires much time, pains, and skill, strict enquiry, and long examination', then, as Kornblith (1993) points out, one will consequently 'find out what, and how many those simple *Ideas* are constantly and inseparably united in Nature, and are always to be found together in the same Subject'. In doing so, one will not end up producing, as in the case of ordinary lay-people, who construct their names of substances in a haphazard and arbitrary way out of, say, convenience, 'gross and confused Conceptions, and unaccurate ways of Talking and Thinking' (Locke 1988: 457).

Therefore, the names of substances, given the rigorous work of 'wary Chymists', and not the arbitrary practices of ordinary lay-people, can at least reveal the 'boundaries' of real 'Sorts' in nature.

So, this is what is ultimately revealed by this crucial passage of Locke's. Although this is the case, it needs to be pointed out here that Locke still, nonetheless, advocates that we can know nothing about these real 'Sorts' in nature at the level of their underlying real essences. This is so, principally because, as spelt out in his primary thesis, we are unable to have any ideas of

them. Thus, given Locke's theory of ideas, there are set limits on how much we can actually know about real 'Sorts' in nature.

To sum up, then, Locke's *alternative* thesis is this: *in sorting things into different kinds in nature* via *their nominal essences, it is assumed that there are in fact real sorts or kinds of things in nature to be discovered (i.e., things which are naturally bounded together into sorts or kinds via their common real essence); moreover, in doing this, one is basically able to identify (as accurately as possible) the boundaries of the different sorts or kinds of things in nature, which means, in other words, that our nominal kinds more or less line up with the real kinds of nature*.

Given this thesis of Locke's it follows that the names of substances can signify more than just mere nominal sorts or kinds of things in nature (as suggested by the primary thesis), which in turn may reflect nothing more than the arbitrary inventions or creations of the human mind (as advocated in the secondary thesis). Instead, they can in fact signify the boundaries of real sorts or kinds of things in nature.

This thesis of Locke's thus proves to be, in contrast to the other two theses, not only *less anti-realist (or nominalist)* about the existence of 'natural kinds' but also *less sceptical* about what can be known about them.

1.3.8 Overview of Locke's account of the names of substances

Locke's overall account of the names of substances is, first and foremost, based on his theory of ideas. Locke endeavours to develop an overall thesis about what the names of substances are not only based on (nominal essences) but also signify (nominal sorts or kinds of things in nature). Locke thus tries to show that the names of substances reflect nothing more than the arbitrary and artificial conceptual constructions of human beings, despite what else has been revealed *via* ultimately the third and final thesis (that the names of substances can in fact signify at least the 'boundaries' of real 'Sorts' in nature). Our conceptual categories can therefore never match up with the real categories of nature. Nature cannot be carved at the joints.

Locke's overall account of the names of substances is thus undoubtedly a *non-realist* (or, *nominalist*) one. For Locke clearly and categorically rejects the possibility of ever knowing what ultimately makes something into a real 'Sort' in nature in terms of real essences. Consequently, as far as Locke is concerned, all our knowledge of the different sorts or kinds

of things in nature, regardless of what else we can know about them, is in terms of nominal essences.

1.4 Locke's account of the corpuscular theory of matter

Nevertheless, real essences can in some way be known on the basis of Locke's empiricism. Although, strictly speaking, it is Locke's view that we can have no immediate or direct ideas of real essences in the way that we can have of nominal essences, we can still use the ideas of sensation and reflection (experience) to speculate indirectly about what they are probably like in terms of their particular make-up. To show this, let us first look at Locke's (1988: 132-143) causal account of perception in which he draws a distinction between the 'primary qualities' and 'secondary qualities' of external objects or 'Bodies'.

1.4.1 Locke's distinction between the 'primary qualities' and the 'secondary qualities' of things

Locke develops his causal account of perception in order to explain how we can come to have 'perceptions' and 'ideas' of the sensible qualities of things. For instance, he wants to explain how it is that we can come to have 'perceptions' and 'ideas' about such things as the yellow colour and hardness of gold, the pain of a knife's blade cutting through our skin, the brightness and heat of the sun, and the melting of wax by the sun. To do this, however, he (1988: 141) invokes the 'corpuscularian Hypothesis' of matter, in which it is hypothesised that the sensible qualities of external bodies are produced as a result of the particular configuration of the insensible parts of matter ('corpuscles'). Thus Locke aims to causally explain the phenomena of how we come to have 'perceptions' and 'ideas' of the sensible qualities of external objects in terms of the real essences of things (specifically, in terms of the insensible 'corpuscular' parts of matter).

To do this, Locke first distinguishes between the 'ideas' we have in our minds and the 'qualities' of external objects. According to Locke (1988: 134), the '*Ideas*' in our minds stand for 'the immediate object of Perception, Thought, or Understanding', while the '*Quality*' of an external object stands for the 'Power' to produce certain 'ideas' of itself in our minds. For example, due to its '*Qualities*' of being white, cold and round, a snow-ball for Locke (1988: 134) 'has the power to produce in us the *Ideas* of *White, Cold,* and *Round*'. Accordingly, for Locke, the 'qualities' of external objects are said to be something which belong to the external object itself, while our 'ideas' of them do not.

From this initial distinction between the 'ideas' we have of the various 'qualities' of external objects and the 'qualities' themselves, Locke subsequently draws a further distinction about the actual 'qualities' of the external objects themselves in terms of 'primary qualities' and 'secondary qualities'.

For Locke, the concept of the 'primary qualities' of external objects is derived as follows. First, Locke (1988: 134) says:

> Qualities thus considered in Bodies are … such as are utterly inseparable from the Body, in what estate soever it be; such as in all the alterations and changes it suffers, all the force can be used upon it, it constantly keeps.

Thus, for Locke (1988: 135), there are certain types of qualities which an external object cannot but have despite whatever happens to them:

> such as Sense constantly finds in every particle of Matter, which has bulk enough to be perceived, and the Mind finds inseparable from every particle of Matter, though less than to make it self singly be perceived by our Senses.

So, for Locke, what are they? Locke (1988: 135) answers this question by the following thought experiment, as pointed out by Downing (1998: 397):

> Take a grain of Wheat, divide it into two parts, each part has still *Solidity*, *Extension*, *Figure*, and *Mobility*; divide it again, and it retains still the same qualities, and so divide it on, till the parts become insensible, they must retain still each of them all those qualities.

Consequently, for Locke (1988: 135):

> division … can never take away either Solidity, Extension, Figure, or Mobility from any Body, but only makes two, or more distinct separate masses of Matter, of that which was but one before, all with distinct masses, reckon'd as so many distinct Bodies, after division make a certain Number.

Since this is the case, for Locke, these inseparable qualities of any external object (from the very largest according to our senses to the very smallest according to our minds) are for him deemed to be the primary ones of all external objects. As such, they form for him (1988: 135) the basis of the 'simple Ideas' which we have of them in terms of what makes up the primary qualities of all external objects: 'Solidity, Extension, Figure, Motion, or Rest, and Number'.

In addition to these primary qualities, external objects also possess for Locke 'secondary qualities'. These 'secondary qualities' are, for Locke, of two types. The first type of 'secondary qualities' are for Locke (1988: 135) those:

> *Qualities*, which in truth are nothing in the Objects themselves, but Powers to produce various Sensations in us by their *primary Qualities*, i.e. by the Bulk, Figure, Texture, and Motion of their insensible parts, as Colours, Sounds, Tasts, *etc*.

While the other type of 'secondary qualities' are for Locke (1988: 135) those ones which are:

> barely Powers … [that] are as much real Qualities in the Subject, as … [are the other] … *secondary Qualities* … For the power in Fire to produce a new Colour, or consistency in Wax or Clay by its primary Qualities, is as much a quality in Fire, as the power it has to produce in me a new *Idea* or sensation of warmth or burning, which I had not felt before, by the same primary Qualities, *viz*. the Bulk, Texture, and Motion of their insensible parts.

So, for Locke, secondary qualities are basically the 'powers' of external objects to produce, as a result of the primary qualities of their insensible parts, certain types of effects: on the one hand, the effect of producing new ideas in us about the sensible qualities of external objects; while, on the other, the effect of making physical changes in the sensible qualities of other external objects. As 'powers', these secondary qualities of external objects are, for Locke, entirely dependent on the primary qualities of the insensible parts of the external objects themselves, which suggests that they cannot exist independently of them.

So, for Locke, the distinction he initially draws between the primary and secondary qualities of all external objects is an ontological one (as noted by Jacovides 2009) in terms of what makes up the basic inseparable qualities of any external object (such as solidity, figure, extension and motion) and what are its basic powers (such as producing new ideas in us and making physical changes in other external objects).

Now, it is in terms of this distinction that Locke seeks to develop a causal account of how we come to have 'perceptions' and 'ideas' of the various sensible qualities of external objects. However, in order to do so, it is not strictly in terms of the ontological distinction just drawn between the primary and secondary qualities of external objects itself. Rather, it is specifically in terms of the causal distinction drawn between *the primary qualities of the insensible parts of matter* and *the secondary qualities of external objects*, as stated in the above quotes about

the powers of the secondary qualities of external objects. For, what is contained in those quotes, is a basic description of the causal relation between the primary qualities of the insensible parts of matter and the secondary qualities of external objects. In short, it is Locke's basic view here that the two basic types of powers of the secondary qualities of external objects are causally produced by the specific make-up of the primary qualities of their insensible parts. Thus, it is not in terms of primary qualities per se that this happens. To think in terms of primary qualities per se is, as Downing (1998: 397) points out, to think in abstract terms. As we shall see, Locke is thinking in less abstract terms than that. Indeed, he is trying to think in terms of ideas which have their original basis in the principal source of experience: sensation.

Bearing all of this in mind, let us now show how Locke goes about developing a causal explanation of how we come to have 'perceptions' and 'ideas' of the sensible qualities of external objects on the basis of how the primary qualities of the insensible parts of matter produce the powers of the secondary qualities of external objects. As we shall see, this 'corpuscularian' account of human perception has its immediate basis in the ideas of sensation – which for Locke is the principal source of experience.

1.4.2 The ideas of sensation as the basis of Locke's concept of the real essences of things

The first thing to explain here is how Locke derives the ideas of the primary qualities of the insensible parts of matter. Locke does so on the basis of his initial ideas of the primary qualities of all external objects or 'Bodies'. As we have already seen in his derivation of the primary qualities of all external objects, Locke proceeds in two steps: by the ideas of 'sense' and by the ideas of the 'mind' (or, as Downing (1998) and Jacovides (2009) like to call it, by the 'sensory' and 'conceptual' steps of Locke's argument). The first step simply involves Locke examining all the external objects of the world on the basis of sensation or his senses. In doing so, Locke observes that all those external objects which are of a large enough size to be perceived by our senses, all possess a specific number of inseparable qualities in terms of solidity, figure, texture, extension, motion and number. These are all perceivable, abstract qualities of which all external objects cannot but possess. To drive this point home, Locke engages in a thought experiment (as I have said). In doing so, it is Locke's basic aim at this stage to simply establish the ontological claim that all external objects, whether they are very large or very small, are all made up of a certain number of primary qualities in terms of solidity, figure, texture, extension, motion and number. However, this is not all that he is doing here. He is also paving the way for saying that even at the level of the insensible parts of matter they too possess these same

primary qualities, even though we cannot perceive them directly. So how does he actually do this? The short answer is: on the basis of the ideas of reflection which have their original source in the ideas of sensation. That is, given the ideas of sensation, Locke consequently infers by the means of mental reflection that if at the observable macroscopic level all external objects possess certain types of inseparable primary qualities as in solidity, figure, texture, extension, motion and number, so it only stands to reason that even at the unobservable microscopic level that the smallest indivisible and insensible parts of matter will also possess these same inseparable primary qualities. This thus constitutes the second step. And it is this step which allows Locke to acquire some indirect, non-sensory ideas about the primary qualities of the insensible parts of matter, despite the fact they cannot actually be perceived directly by our senses, i.e., by the principal source of experience in terms of sensation. The upshot of this is that though we cannot have any direct ideas of the primary qualities of the insensible parts of matter, we can nonetheless imagine what they are. That is, we can imagine that in principle the primary qualities of the insensible parts of matter are just like the primary qualities of external objects which are large enough to be perceived by our senses. And because we can do this, we can therefore have some indirect ideas about the primary qualities of the insensible parts of matter, but only because they have their original source in the ideas of sensation. So if, for instance, we have observed at the macroscopic level that a certain external object has a square figure, is solid and moves around in a darting way in empty space, then it is possible to infer by the means of mental reflection that at the microscopic level there will also exist something similar, i.e., some insensible part which is also of a square figure which is hard and moves around in a darting way in empty space. For Locke, then, this is how he derives these indirect, non-sensory ideas about the primary qualities of the insensible parts of matter. Thus, it is by this method that Locke derives some indirect, non-sensory ideas about the real essences of things.

Let us now look at how Locke actually develops his causal account of how we come to have our ‘perceptions’ and ‘ideas’ of the sensible qualities of external objects on the basis of such real essences as the primary qualities of the insensible parts of matter (the ‘corpuscular’ parts of matter). In so doing, Locke (1988: 547) is offering an account of such phenomena on the basis of the ‘corpuscularian Hypothesis’ of matter, which in his view (as I have already pointed out) went the ‘farthest in an intelligible Explication of the Qualities of Bodies’.

1.4.3 Locke's corpuscularian causal account of our 'perceptions' and 'ideas' of the sensible qualities of external objects

Firstly, for Locke (1988: 136), the only way by which the primary qualities of the insensible parts of matter (the corpuscular essences of things) can produce 'perceptions' and 'ideas' in us of the sensible qualities of external objects is by what he calls '*impulse*'. By this Locke (1988: 136) simply means that it occurs by some physiological 'motion' within us:

> 'tis evident, that some motion must be thence continued by our Nerves … by some parts of our Bodies, to the Brains or seat of Sensation, there to *produce in our Minds the particular* Ideas *we have of them*.

In short, the various 'perceptions' and 'ideas' of the sensible qualities of external objects are conveyed to us via the sensory parts of our nervous system to be then registered in or by our 'Minds'. Accordingly, for Locke, since:

> the Extension, Figure, Number, and Motion of Bodies of an observable bigness, may be perceived at a distance by the sight, 'tis evident some singly imperceptible Bodies must come from them to the Eyes, and thereby convey to the Brain some *Motion*, which produces these *Ideas*, which we have of them.

And given how we come to perceive via this physiological motion of impulse some of the 'original Qualities' of external objects (i.e., their observable primary qualities), it follows for Locke (1988: 136) that something similar occurs with respect to how we come to have some 'perceptions' and 'ideas' of the secondary qualities of external objects:

> After the same manner, that the Ideas of these original Qualities are produced in us, we may conceive, that the *Ideas of secondary Qualities* are also *produced*, viz. *by the operation of insensible particles on our senses*.

Thus, for Locke, it is by this physiological mechanism of the human nervous system – the motion of impulse – that we are able to perceive any of the sensible qualities of the external objects of the world.

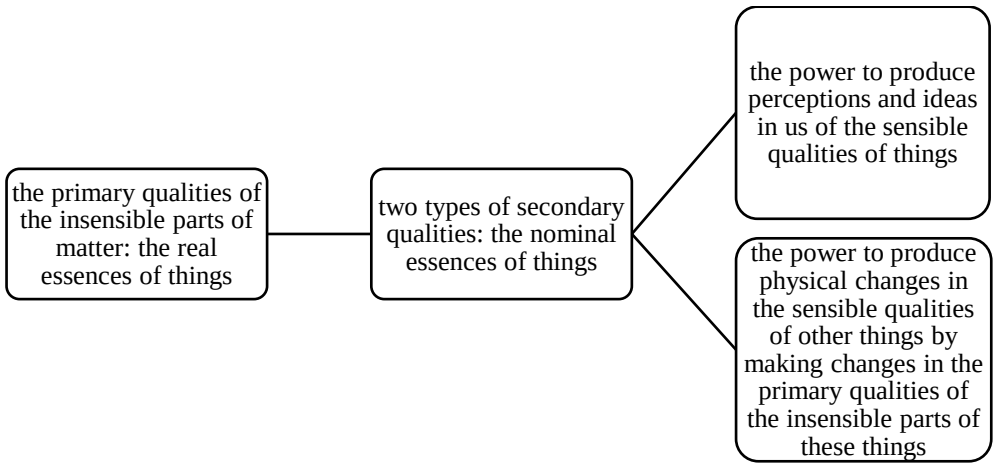
With this said, we can now explain how for Locke the primary qualities of the insensible parts of matter ('corpuscles') produce the secondary qualities ('powers') of the external objects, which in turn allow us to both perceive and formulate ideas of the insensible qualities of things.

According to Locke, the various secondary qualities of the external objects of the world in terms of their respective powers (as in producing new ideas in us and making physical changes to things) are causally produced by the particular arrangements and types of the primary qualities of the insensible parts of matter. So, for example, in order to perceive and have an idea about the sensible qualities of a piece of gold (such as its shiny yellow colour, hardness, heaviness and malleability) is all dependent on the specific type and arrangement of the primary qualities of its insensible parts. So, if the insensible 'corpuscular' parts of piece of gold is comprised of *x*, *y* and *z* primary qualities in terms of size, solidity, figure, extension, number and motion, and they are all arranged and/or interact in a certain way, then as a result they will produce the specific secondary qualities that they possess in terms of their various powers. So, in the case of gold here, it comes to possess those specific secondary qualities which have the power to produce in us certain perceptions and ideas about its various sensible qualities, such as its shiny yellow colour, hardness, heaviness and malleability. Also, given the particular type and arrangements of the primary qualities of its insensible 'corpuscular' parts of matter, it has the particular secondary quality in which it has the power to be melted or dissolved in *aqua regia* (a solvent). Thus, for Locke, a piece of gold cannot possess these specific types of secondary qualities with their associated powers unless it is internally made up of a specific type and arrangement of the primary qualities in terms of its insensible 'corpuscular' parts of matter.

Now, as can be seen here in this example of gold, the causal account of how it comes to have the specific sensible qualities that it does is all in terms of the corpuscularian hypothesis of matter of Locke's time. For, what this hypothesis asserts is that all the 'qualities' of external objects can be causally accounted for (i.e., explained) in terms of the specific type and arrangement of the primary qualities of the insensible 'corpuscular' parts of matter. So, if you want to causally explain how water can freeze or melt, or how the sun can burn brightly and warm us, or how gold but not lead can dissolve in *aqua regia*, or how the sensible qualities of any other external object are produced, then, as far as Locke is concerned, this can all be done on the basis of the corpuscularian hypothesis of matter as formulated in terms of the distinction he draws between the primary qualities of the insensible parts of matter and the secondary qualities of external objects. And furthermore, it is by this hypothesis that our perceptions and ideas of the sensible qualities of things can be causally accounted for too. As discussed, they are the direct result of the various powers of the secondary qualities of all external objects.

This account of Locke's corpuscularian theory of matter has been mainly couched in causal rather than metaphysical or ontological terms, as I take Locke to be mostly concerned with presenting a causal account of matter rather than just offering a metaphysical or ontological one. But while I emphasise this, it should be noted that Locke's views of the 'powers' of the secondary qualities of all external objects is definitely couched in metaphysical or ontological terms. For it is Locke's view (as I have already indicated) that 'powers' are nothing but the effects of the specific configuration of the primary qualities of the insensible parts of matter. For Locke, if the specific configuration of the primary qualities of the insensible parts of matter is not present, then you will not consequently get certain types of secondary qualities with their specific types of powers. Equally, for Locke, even when the specific configuration of the primary qualities of the insensible parts of matter of an external object is present, it does not necessarily mean that its particular type of secondary qualities with their specific types of powers will be perceivable by us. Locke (1988: 139) illustrates this metaphysical or ontological point by the example of porphyry, wherein he says that its reddish and whitish colours disappear when there is no light shining on it. Now, it is not my intention here to open up a philosophical can of worms about whether the 'secondary qualities' of external objects really exist just like the primary qualities of the insensible parts of matter supposedly do. I simply raise it in order to point out that Locke nevertheless views the 'secondary qualities' of all external objects in a certain metaphysical or ontological way. Whether his view is correct is not at issue here, as it does not bear down on his causal account of the corpuscular make-up of matter and how it is all ultimately based on the indirect or non-sensory ideas of experience.

Let us thus graphically represent Locke's corpuscularian causal account of matter:



As can be seen here, the primary qualities of the insensible parts of things are the real essences of things while the secondary qualities of things are the nominal essences of things. The subsequent powers that these secondary qualities of things have (such as producing perceptions and ideas in us of the sensible qualities of things) are all causally determined by the specific make-up of the primary qualities of the insensible parts of matter. So, while there is an ontological distinction to be drawn between these two aspects of things in terms of their real and nominal essences, the actual relation between them is nevertheless a causal one. With this said, let us now briefly consider whether Locke thinks it is in fact possible to have any direct sensory ideas of the real 'corpuscular' essences of matter and what its upshot is.

1.4.4 How the real essences of matter are in principle observable

Locke (1988: 301), at one point in the *Essay*, says:

> Had we Senses acute enough to discern the minute particles of Bodies, and the real Constitution on which their sensible Qualities depend, I doubt not but they would produce quite different ideas in us; and that which is now the yellow colour of Gold, would then disappear, and instead of it we should see an admirable Texture of parts of a certain Size and Figure.

The evidence for imagining this is provided for Locke (1988: 301) by what a microscope reveals to us about things which are too small for us to see with our naked eyes:

> This Microscopes plainly discover to us: for what to our naked Eyes produces a certain Colour, is thus by augmenting the acuteness of our Senses, discovered to be quite a different thing, and the thus altering … the proportion of the Bulk of the minute parts of a coloured Object to our usual sight, produces different *Ideas*, from what it did before.

Thus, for Locke (1988: 301), such things as:

> Sand, or pounded Glass, which is opaque, and white to the naked Eye, is pellucid in a Microscope … and … Blood to the naked Eye appears all red; but by a good Microscope, wherein its lesser parts appear, shews only some few Globules of Red, swimming in a pellucid Liquor.

Indeed, for Locke, if we had even more powerful microscopes than we did then it would be possible to see how the red drops of blood would appear in terms of its smaller parts.

So, as can be seen here, it is clearly Locke's view that we can certainly come to observe, at least in principle, the smallest parts of matter and in doing so possibly come to observe the primary qualities of the insensible parts of matter themselves. Given this, it seems that for Locke it is consequently possible, at least in principle, for us to acquire by a very powerful microscope some direct sensory ideas of the real essences of matter in terms of the primary qualities of the insensible parts of matter.

Now, if this were at all possible, what would it mean for Locke? In brief, it would mean for Locke that our actual knowledge of the real essences of things would be based more firmly on the ideas of sensation rather than any metaphysical speculations about them, which is for him a prerequisite if we are to advance our knowledge of how the real essences of things produce their nominal essences. However, for Locke, this was not actually possible at the time. Even so, as I shall now show, Locke nevertheless thought it was possible to arrive at some probable knowledge of the real essences of things and how they might, in all probability, produce the nominal essences of things. The key to all this was for Locke the use of analogies by the practitioners of the corpuscularian hypothesis, like Boyle.

1.4.5 The use of analogies and inferences to the probable explanation of things

In a lengthy but all-important passage, Locke (1988: 665) first says:

> Concerning the manner of Operation in most parts of the Works of Nature … [that] … though we see the sensible effects, … their causes are unknown, and [so] we perceive not the ways and manner [of] how they are produced.

Thus, for Locke (1988: 665), we see that:

> Animals are generated, nourished, and move; the Load-stone draws Iron; and the parts of a Candle successively melting, turn into flame, and give us both light and heat.

So, for Locke (1988: 665), '[t]hese and the like effects we know'. However, for Locke (1988: 665), what we do not know are 'the causes that operate, and the manner they are produced in'. Concerning them, 'we', as Locke (1988: 665) says, 'can only guess, and probably conjecture' about, because '[t]hese and the like coming not within the scrutiny of our Senses, cannot be examined by them, or be attested by any body'. So, for Locke (1988: 665), they:

> can only appear more or less probable, only as they more or less agree to Truths that are established in our minds, and as they hold proportion to other parts of our Knowledge and Observation.

Therefore, for Locke (1988: 665):

> *Analogy* in these matters is the only help we have, and 'tis from that alone we draw all our grounds of probability.

So, for Locke (1988: 665-66), in observing for example 'that the bare rubbing of two Bodies violently one upon another, produces heat, and the very often fire it self', we are consequently led to believe via analogy 'that what we call Heat and Fire, consists in a violent agitation of the imperceptible minute parts of the burning matter'. That is, we guess how this all probably happens by drawing an analogy with those observable things which we perceive via our senses. But in doing so, we are nevertheless drawing upon some ideas of sensation in order to guess or conjecture about the probable causes and way something happens, such as how heat and fire are produced.

Now, for Locke (1988: 667), it is by the method of analogy that we can often make discoveries 'of Truths … which would otherwise lie concealed'. Specifically, what he has in mind is in terms of the real essences of things. Thus, for Locke, it is possible to use the method of analogy to help us guess or conjecture about how the specific primary qualities of the insensible parts of matter might, in all probability, produce the sensible qualities of things, like heat and fire. Indeed, on this basis, it is possible to make what are basically inferences to the probable explanation of things. Of course, for Locke, this does not actually mean that this is literally done at the level of the ideas of sensations. We still, on this method, can only ever have some indirect sensory ideas about how the real essences of things (the insensible corpuscular parts of matter) might produce the various nominal essences of things (the sensible qualities of things). Nevertheless, for Locke, it is a major step in perhaps getting some greater knowledge of how the real essences of things produce the nominal essences of things.

1.4.6 Overview of Locke's account of our ideas of real essences

Locke's account of the unknown real essences of matter is, as we have seen, based on the ideas of reflection which are in turn based on the ideas of sensation. For Locke, we are thus able to have some non-sensory ideas of the unknown real essences of matter since the ideas that we formulate about them are themselves based indirectly on some original ideas of sensation. This

is what Locke's derivation of the ideas of the primary qualities of the insensible parts of matter demonstrates. We come to conceive that all insensible parts of matter, just like pieces of matter which are of a large enough size to be observed, possess certain inseparable primary qualities – such as solidity, figure, texture, extension, motion and number. In a sense, we can almost visualize them with these specific primary qualities, even though we cannot of course directly perceive them. As a result, we can causally explain the nominal essences of things (their sensible qualities) by their real essences (the primary qualities of the insensible 'corpuscular' parts of matter). Also, it is consequently on this basis that we can then draw analogies with what is happening at an observable macroscopic level in terms of the sensible qualities of external bodies in order to infer what is probably happening at an unobservable microscopic level in terms of the insensible parts of matter. This method of analogy, which rests on our ideas of sensation, allows us to draw inferences about the probable truth or explanation of things, such as how the heat of something is due to a certain rapid agitation of its insensible parts just like the rapid agitation of boiling water.

So, when it comes to having some non-sensory ideas about the real essences of things, Locke, unlike in his account of the names of substances, is somewhat of a *realist* rather than a non-realist. For it seems that Locke takes seriously the possibility that the real essences of things are somewhat knowable, even if it is only in a rather metaphysically speculative way. Thus, for Locke, while it might not be possible to classify things by their real essences, it does not follow that we cannot still have some provisional knowledge about the real essences of things (i.e., the particular constitution of the primary qualities of the insensible corpuscular parts of matter), which in turn can be used to explain the nominal essences of things (i.e., the sensible qualities of external objects).

1.5 Locke's empiricism as a basis for two trends in the philosophy of science: positivism and scientific realism

Having presented Locke's two different accounts about our knowledge of things in terms of their real and nominal essences, let us now consider how Locke's empiricism becomes a basis for two different trends in the philosophy of science: positivism and scientific realism. I shall first outline the basic views of what is called 'positivism' and 'scientific realism' in the philosophy of science.

1.5.1 The basic views of positivism and scientific realism

First, positivism is the view that when it comes to the task of revealing the underlying reality behind the observable phenomena of the natural world – i.e., the real causal structure which in turn gives rise to and hence provides an explanatory account of the observable qualities and properties of various things – then science is unable to do this. Instead, all science can aspire to do is give a descriptive account of the observable patterns of phenomena, as Godfrey-Smith (2003: 25-30 and 34-36) points out. So, for instance, it is not possible according to positivism for science to reveal that the various observable qualities and properties of water are due to its purported molecular structure, H_2O. Rather, all science can do here is provide descriptive accounts of the observable behaviours and features of water, such as how it turns to steam or ice due to certain variations in temperature. The primary reason for this positivistic view of the main aim of science is that we cannot know anything beyond the realm of experience, as Chakravartty (2010: 13-16) points out. In short, we can only ever know what is observable on the basis of our sense perceptions. Consequently, this rules out anything which is deemed to be an unobservable, such as atoms and molecules.

In contrast, scientific realism is the view that science is able to reveal the underlying reality of the observable phenomena of the natural world and in doing so show how the particular qualities and properties of things are determined by their specific causal structures. As such, scientific realism holds that the aim of science is not just about giving descriptive accounts of the observable patterns of phenomena (the positivist view) but also explanatory ones in terms of its unobservable causal structures, as pointed out by Godfrey-Smith (2003: 36). So, scientific realism rejects the positivist view that we can know nothing beyond the realm of experience. In doing so, however, scientific realism does not reject the empiricist thesis that experience is the source of all knowledge (which is also accepted by positivism), as pointed out by both Rosenberg (2012: 10) and Chakravartty (2010: 15). Indeed, scientific realism (and this is where it differs from positivism) holds that it is on the basis of experience that science is able to make inferences about the hidden causal structures of phenomena, as claimed by Psillos (2010: 167-94).

In terms of Locke's distinction between the real and nominal essences of things, we can thus say that (1) *positivism is the view which holds that science can only ever know the nominal, and not the real, essences of things*, whereas (2) *scientific realism is the view which holds that science can in fact know (to some degree) the real essences of things*.

Given these basic Lockean views of positivism and scientific realism, how is Locke's empiricism a basis for both the positivist and scientific realist trends in the philosophy of science? As I shall now show, Locke's account of the names of substances leads to positivism because it denies that we can ever know the real essences of things on the basis that we can only ever have direct sensory ideas of the nominal rather than the real essences of things, whereas his account of the corpuscular theory of matter leads to scientific realism since it is in fact possible to know (although only to a limited degree) the real essences of things on the basis of some non-sensory ideas we have about them. In both cases, Locke's empiricism is a basis for these two trends in the philosophy of science given his theory of ideas (the cornerstone of his theory of knowledge).

1.5.2 How Locke's empiricism leads to positivism

As we have seen in Locke's account of the names of substances, the natural substances of the world are all sorted and named in accordance with their nominal essences, which stand for nothing else but the abstract ideas we have of them. Our ideas of their nominal essences are derived via the principal source of experience: sensation. Thus, our ideas of them are based directly on the ideas of sensation. For Locke, as we have seen, these are the only sorts of ideas we can have of the natural substances of the world. We are unable to acquire any other sorts of ideas about them. Consequently, we can only ever base our classifications of the natural substances on their nominal essences since our knowledge cannot extend beyond the nominal essences of things. In short, we cannot know anything beyond our immediate sensory experiences of the natural world which is the basis for our ideas of things. So, for Locke, the natural philosophers of his time (the 'wary chymists', like Boyle for instance), must consequently do their scientific work in accordance with what can actually be known on the basis of their sensory experiences of the world – i.e., by their sense-perceptions. As a result, their knowledge of the world, as represented by their natural classification of things, is limited to a knowledge of the nominal essences of things. They can thus never know the real essences of things which, if they could be known, would allow them to carve nature at the joints.

Given Locke's overall account of the names of substances and how it is based on the core empiricist claim that we can only ever know things about the natural world which are based directly on the ideas of sensation, then in terms of science we may infer that it is limited to a knowledge of just the nominal essences of things. If this is accepted as a plausible philosophical thesis about the extent and limit of our scientific knowledge of the natural world, then from a

philosophy of science perspective it might be concluded that since that is the case then science should only aim to know the nominal, and not the real, essences of things. In doing so, one would be espousing a positivist view about the central aim of science. Indeed, one might go so far as to recommend (as we shall see in the chapter on Hume) that science should just aim to develop a scientific knowledge of the natural world based on their nominal essences, since real essences (given Locke's empiricist account of the names of substances) are unknowable. And they are unknowable (apparently) because we can have no direct sensory ideas of them.

So, it is in this sense, that Locke's empiricism can become a basis for a positivist trend in the philosophy of science. This is, however, one interpretation of Locke's empiricism. In order to maintain it, it would require that we overlook Locke's empiricist account of the corpuscular theory of matter. For, as I shall now show, this empiricist account of Locke's has the epistemological ingredients for developing a scientific realist view of science. As such, Locke's empiricism can also become a basis for a scientific realist trend in the philosophy of science.

1.5.3 How Locke's empiricism leads to scientific realism

In his account of the corpuscular theory of matter, Locke shows that it is in fact possible for us to acquire some non-sensory ideas about the insensible corpuscular parts of matter, based on some of our original sensory ideas about the sensible qualities of things. In short, it is by the ideas of sensation (the primary source of experience) that we can infer some non-sensory ideas about the corpuscular make-up of matter. Because of this, we can then speculate about what makes up the specific primary qualities of the insensible parts of matter which in turn give rise to not only our perceptions and ideas about the sensible qualities of external objects, but also how they produce physical changes in other external objects by changing the make-up of the primary qualities of their own insensible parts of matter. Thus, we can speculate about how the specific primary qualities of the insensible parts of matter produce their specific powers ('secondary qualities').

What this consequently illustrates is that, despite the central claim of Locke's account of the names of substances about how we can never classify the natural substances of the world in terms of their real essences since we have no direct sensory ideas of them, we can (as it turns out) come to have some ideas about the real essences of matter. Now, while our ideas of them may be somewhat speculative as they are still not based on any direct sensory ideas (i.e., the ideas of sensation), we can nevertheless guess, *especially via the method of analogy*, how in

all probability the various nominal essences of things are produced by their specific real essences.

Since this is the case for Locke, it can be inferred that Locke is effectively espousing *a scientific realist view* about not only the central aim of science but also what it can possibly reveal in terms of the real essences of things. Importantly, this is all done on the basis of his empiricism; specifically, it is done via the ideas of reflection which have their original source in the ideas of sensations (the primary source of experience). As I have already pointed out (see section 1.1), it is nevertheless possible to acquire some ideas of things via another source (reflection), if it is ultimately derived from the original source of the ideas of things: sensation. If it is not done this way, then of course there can be no ideas of anything as they not based on the ultimate source of knowledge: experience.

In light of this, we can say that Locke's empiricist account of the corpuscular theory of matter provides a basis for a scientific realist trend in the philosophy of science. Indeed, it paves the way for saying that science not only aims to but also can in fact know (to some degree) the real essences of things.

So, if one also focuses on this aspect of Locke's empiricist philosophy, it is not possible to claim that his empiricism leads only to positivism in the philosophy of science. You can only say that, if you take Locke to be saying that there can be no ideas of anything (such as real essences) unless based directly on the ideas of sensation: the primary source of experience. However, if you also take Locke to be saying that we can in fact have some non-sensory ideas of things, then it is indeed possible to come to know some aspects of the real essences of things and how they generate the nominal essences of things.

1.6 Conclusion

In this chapter, I have shown how Locke's empiricism becomes a basis for two trends in the philosophy of science: positivism and scientific realism. Given his classificatory account of the names of substances, Locke's empiricism is a basis for positivism because it leads to the view that denies that science can ever know the real essences of things. Equally, given his account of the corpuscular theory of matter, it is a basis for scientific realism because it leads to the view that science can in fact attempt to know the real essences of things. Locke's empiricism is therefore ambiguous between positivism and scientific realism.

If we only focus on that aspect of Locke's empiricism which says that we can never have any ideas of things except those which are based directly on the primary source of sensation, then it is no wonder that we can never know anything except the nominal essences of things. However, if we use our ideas of sensation as the basis for inferring what things might be probably like, then it is possible to have some indirect ideas about the real essences of things. Of course, this does not mean that what Locke has to say about the real essences of things in terms of the 'corpuscular' make-up of matter is correct; nor that we can never come to know what things are really like in terms of the real essences of matter. So, rather than assuming that Locke's empiricism is a basis for just positivism, it would be better to conclude that it is a basis for both positivism and scientific realism in the philosophy of science.

2

The problem of Locke's account of essences as the unknown basis of phenomena

2.0 Introduction: outlining the problem and its solution

For Locke, real essences are the unknown basis of phenomena. They are the unknown causal foundations which make something not only be what it essentially is but also what makes it have its specific observable qualities and properties. This is because we can have no direct ideas of them via our sensory perceptions (unlike nominal essences). So, on this account, it is not possible to have any direct ideas of the alleged primary qualities of the hypothesised corpuscles of matter which purportedly give rise to the secondary qualities of the external objects of the world, which in turn form the causal basis of our perceptions and ideas of the sensible qualities of external objects. Nor is it possible to have any direct ideas of what really determines (if anything) the natural classifications of substances, such as gold and lead. Nor is it possible to have any direct ideas of what causes gold but not lead to dissolve in *aqua regia*. For these are all instances of what Locke takes to be real essences.

Nonetheless, for Locke, we can still speculate (at least in principle) about them on the basis of ideas acquired by either sensation or reflection. For instance, on the basis of what are the alleged essential or primary qualities of macroscopic objects (objects of a large enough size to be perceived by our unaided senses), it is possible to infer (at least to a limited degree) what are the essential or primary qualities of the microscopic parts of which they are supposedly made up. This is because, regardless of whether an object is very large or very small, it would seem to possess the same essential or primary qualities of all other objects. So, if size, shape and motion are always found to be inseparable in all objects of a large enough size to be perceivable by our senses, then in all likelihood these very same essential or primary qualities will also be found to be inseparable in the smallest indivisible parts of matter (corpuscles), despite not being immediately perceivable by our ordinary unaided senses.

Whilst Locke takes real essences to be the unknown basis of phenomena, he does not hold that they are in principle unknowable. The issue for Locke is a contingent one. Real essences are unknown to us because we lack the requisite abilities to know them directly via our senses (which is the primary experiential source of gaining ideas about the phenomena of the natural world). We are unable to directly observe or perceive the alleged corpuscles of matter because they are too small or minute for our eyes to detect them. However, if as Locke suggests in the *Essay*, we had eyes which acted like very powerful microscopes, then in principle we would be able to directly observe or perceive these alleged corpuscles of matter. So, the fact that we do not know what the real essences of matter are is not due to them being unknowable in principle. Instead, they are simply unknown to us in our current state; which means of course they may not always be unknown to us.

So, the problem here is this. Locke has an account of essences as the unknown basis of phenomena. Nevertheless, as we have just seen, he is able to speculate about them on the basis of his empiricist theory of ideas, as being based on the purported corpuscular structure of matter. However, what he is not able to do is to say how they may actually be known. The best that Locke can do is to suggest that the only way we might come to reveal some truths about the natural world at the level of real essences is via the method of analogy. By drawing an analogy with what we observe at the level of nominal essences, we might be able to reveal and/or discern what is occurring at the level of real essences (e.g., real essences are like keys which unlock certain door locks, heat is the result of agitated particles, and so on). But the problem with this approach is that it lacks any experimental confirmation or evidence. Furthermore, it does not reveal what the real essences of phenomena are really like and how they actually give rise to their nominal essences (e.g., what are corpuscles and how do they combine together in order to produce the sensible qualities of phenomena?). So, the real problem of Locke's account of essences as the unknown basis of phenomena is that it lacks any actual scientific evidence for the existence and reality of them (i.e., atoms or corpuscles). Instead, it simply rests on metaphysical speculations. As Chalmers (2009) for instance might say, Locke's account of essences as the unknown basis of phenomena is based on philosophical speculations (*a priori* theorising) rather than any scientific evidence (*a posterior* work).

So, how do we go about solving this problem? Is it solvable? If so, what does it say critically about Locke's account of essences as the unknown basis of phenomena? What is the source of the problem? Is it the basis of Locke's philosophy – his empiricist theory of ideas? Or is it simply the fact that the mechanical philosophy (or corpuscularianism) of Locke's time (to

which he subscribed) provided no satisfactory basis on which to mount a full-blown scientific realist account of real essences?

In this chapter, I shall attempt to sort this problem out, i.e., the problem of Locke's account of essences as the unknown basis of phenomena. My answer, in short, will be that Locke's account of the essences of phenomena is based on the metaphysical speculations of the mechanical and/or natural philosophy of Locke's time, as evinced in the work of both the chemist, Robert Boyle, and the mathematical physicist, Isaac Newton. And the problem with this is that although such speculations might be roughly right in that they are pointing in more or less the right direction, they nonetheless lack any experimental confirmation (i.e., empirical support). Hence, it is no wonder then that Locke might be somewhat sceptical (or, as Kornblith (1993) says, even pessimistic) about our ability to discover what the unknown essences of phenomena are. Notwithstanding this, I shall show that the essences of phenomena (Locke's real essences) are nonetheless discoverable, but only by the theoretical and experimental methods of science rather than by any *a priori* reasoning on the part of natural philosophy (specifically, the metaphysical speculations of mechanical philosophy). This, I shall do by concentrating on a particular episode from the history of modern natural science: the problem of Brownian motion and the Einstein-Perrin proof of the atomic-molecular structure of matter. At the end, my overall conclusion will be that Locke's inadequate account of the unknown essences of phenomena is primarily due to the metaphysical speculations on which it is based, plus not having the resources to explain the inner structure of matter. Whilst his actual empiricist philosophy in terms of his theory of ideas does play some role, it does not strictly hinder a proper development of a scientific realist account of the essences of phenomena (despite what Kornblith (1993) for instance says, which is that Locke's empiricist theory of knowledge and his empiricist theory of meaning blocked him from developing a full-blown scientific realist view of science). Locke (just like his scientific contemporaries) conceptualises the 'atoms' and 'corpuscles' of matter as 'miniature inert stones' (Chalmers 2009) – i.e., he conceptualises them on the only basis available to him in terms of the ideas of experience, plus the mechanical science of his day.

2.1 The 'corpuscularian Hypothesis' of Boyle and Newton

To show what is wrong with Locke's account of essences as the unknown basis of phenomena, I start with a critical account of what he took to be the best available hypothesis of his times –

the ‘corpuscularian Hypothesis’ of matter. As I shall show, Chalmers (2009) for instance disputes this type of claim on the grounds that it is not experimentally confirmed by science.

2.1.1 The atomism of Boyle and Newton

I shall start by first outlining the atomistic accounts of both the chemist, Robert Boyle, and the mathematical physicist, Isaac Newton. These accounts of theirs are developed, as Chalmers (2009) points out, by (1) observing the objects of the world, (2) abstracting their common features and (3) turning them into ‘fundamental principles’ of the basic units or the smallest parts of matter: atoms or corpuscles. As a consequence, they conceive atoms as ‘miniature inert stones’ and corpuscles as small clusters or groups of ‘miniature inert stones’ (Chalmers 2009).

Boyle’s and Newton’s atomism is a revised version of ancient Greek atomism. Epicurus, as Chalmers (2009) points out, held ‘atoms’ to be physically indivisible, of certain sizes and shapes, and moving around in a ‘void’. The explanations for different phenomena would be in terms of how these atoms collided and combined with each other in the void. The model for conceptualising the atoms and the void was in terms of observing how objects like ‘stones’, ‘hooks’, ‘eyes’, etc. would collide and combine with one another. So, the method of conceptualising them was an empiricist one. However, the problem with this approach (as with the whole approach of all atomistic theories of matter prior to the nineteenth century) was that it lacked any experimental confirmations and/or empirical evidence for the atomistic structure of matter. Consequently, they proved to be nothing more than mere philosophical speculations. This is, notably, a central theme in Chalmers’s (2009) book.

Boyle holds that phenomena are to be accounted for in terms of the fundamental properties of size, shape and motion and the combinations of the basic units of matter (atoms). Newton’s conception of the fundamental properties of the basic units of matter (atoms) is like Boyle’s, except that it adds onto it the principle of attraction and repulsion between the basic units of matter as well as mass.

Given these atomistic accounts of both Boyle and Newton, it is fairly clear that Locke (1988: 134) draws upon them in putting forth his account of the primary/secondary qualities distinction in Chapter VIII of the *Essay*, wherein he conceptualises the primary qualities of the minute ‘insensible parts’ of matter as consisting of such things as ‘Bulk, Figure, Texture, and Motion’. As Locke (1988: 140) says in the *Essay*, he has ‘been engaged in Physical Enquiries’ which have their origins in the ‘Natural Philosophy’ of Boyle and Newton.

2.1.2 The problem with the atomism of Boyle and Newton

As Chalmers (2009) points out, the atomism of the mechanical or natural philosophy of Boyle and Newton is metaphysical speculation without experimental confirmation. As a result, it seeks to accommodate, as Chalmers (2009) says, its atomism with the data of experience rather than experimentally confirm it as a scientific hypothesis of matter. The atomistic theories of both Boyle and Newton stand in contrast to their more experimentally-based work. Boyle's experimental work does not seek to support any ultimate causal explanations of phenomena; rather, it seeks to support only intermediary causal explanations which are confirmed by empirical evidence. Newton's atomism is more developed than Boyle's because it offers an explanation of how atoms and corpuscles may attract or repel each other. This means that Newton is at least able to explain how in principle atoms may or may not combine with each other. For example, objects with greater and heavier mass (e.g., pieces of lead and gold) are due to the purported fact that their atoms have a stronger attraction to each other and so cohere together into a tighter fit, whereas objects with a lesser and lighter mass (e.g., an air balloon) are due to the purported fact their atoms are more repulsive with one another and so do not cohere together.

The atomism of mechanical philosophy is preferable to the Scholastic accounts of the time (the Doctrine of Substantial Forms), since the latter are not based on anything which at least seems plausible from the standpoint of empiricism. As a result, even though it might not be possible to substantiate the atomistic account of matter, we can at least discard the Scholastic accounts instead.

Given that Locke's account of essences as the unknown basis of phenomena is based on the atomistic/corpuscularian accounts of the mechanical philosophy of his era, it follows that it too then is based on the metaphysical speculations of natural philosophy (specifically, the *a priori* reasoning of the mechanical philosophy of both Boyle and Newton). Thus it too suffers from a lack of experimental support with empirical evidence. Locke's conception of the essences of phenomena is construed in empiricist terms, just as the conception of the mechanical philosophers is. Locke construes the so-called atoms and/or corpuscles of matter as if they are 'miniature inert stones' with their own specific sizes, shapes and motions, although they are impenetrable. He does this by attributing to them the common qualities he has perceived in all observable external objects – such as being of a certain size, shape and motion.

Locke uses his method of abstraction to do this. It is noteworthy that while Locke's method of abstraction is generally used to pick out the common features of different species of things from organic to inorganic ones which are then designated by general words or names, it is used here in such a way as to pick out the principal qualities of the basic units of matter, i.e., the primary qualities of the minute indivisible parts of matter. In so doing, Locke is using this method of abstraction to articulate his conception of the basic units of matter. However, just like the mechanical philosophers of his era (Boyle and Newton), he consequently makes them the fundamental principles of the basic units of matter. But since Locke has no experimental grounds for claiming this, he has no choice if he wants to articulate what he thinks are the primary qualities of these basic units of matter to fall back on the ideas of experience. Of course, in doing so, he is only offering philosophical rather than scientific reasons for his particular conception of the primary qualities of the basic units of matter. That is, he offers reasons which are based on the use of 'inferences to the best explanation', as Chalmers (2009: 8-10) would say, rather than 'inferences to the right explanation' in constructing his account of what are the primary qualities of the basic units of matter.

Since Locke's account of the essences as the unknown basis of phenomena is metaphysical speculation, on *prima facie* grounds we have no reason to expect that either (1) we can ever discover the actual essences of phenomena or (2) know how they may consequently produce their observable qualities and properties. Locke is of course quite aware of this predicament. As we shall see with Hume's empiricist philosophy, this is the sort of conclusion Hume draws about the hidden essences of phenomena. Hume says that since they are unknowable, they should be discarded. However, this is not Locke's view. His problem is that the essences of phenomena are simply unknown to us, given the current state of science in his era. Hence, the problem for him is a contingent one. If science could actually reveal the hidden essences of phenomena, Locke would accept what science has done. Thus Locke's, unlike Hume's, empiricism does not necessarily preclude that science can in principle reveal the hidden essences of phenomena and as a result provide us with scientific knowledge about not only their fundamental properties but also how they causally produce the observable features of phenomena. However, this is so only if we accept that science has no other means available to it than the *a priori* thinking or metaphysical speculations of natural philosophy. As I am now about to show via a crucial episode from the history of modern science – that of the phenomenon of Brownian motion and the Einstein-Perrin proof of the atomic-molecular structure of matter – it is indeed clearly possible (as it has turned out) for science to reveal the

essences of phenomena via the very methods that distinguish science from philosophy. As Chalmers (2009) points out, it is by the theoretical and experimental approaches that were already being employed within the scientific work of both Boyle and Newton.

2.2 An assessment of Locke's views *via* the history of modern science

By turning to the history of modern science, it is possible to show that essences (as Locke understood them) are no longer the unknown basis of phenomena. This is evident in the theoretical and experimental work done on establishing the reality and/or existence of atoms (the real essences of matter).

Two points to bear in mind as we assess Locke's views about the unknown essence of phenomena. Firstly, Locke's paradigm of the real and nominal essence distinction is in terms of the metaphysical conception of the 'corpuscular constitution' of all living and non-living forms of matter (i.e., the 'corpuscular Hypothesis') and their observable qualities, whilst, in modern scientific times, it is in terms of the atomic-molecular hypothesis of matter and the observable (or manifested) characteristics of various phenomena. Secondly, the atomic-molecular hypothesis of matter, which in turn is used as the basis for causally explaining all sorts of chemical and physical phenomena, is ultimately established by the theoretical and experimental proofs of science.

2.2.1 The state of natural science at the beginning of the nineteenth century: chemistry

I shall start by saying something about the state of natural science (in the form of chemistry) as it was at the beginning of the nineteenth century. This will be done by looking briefly at John Dalton's explanation of the phenomenon of chemical combination on the basis of his atomic hypothesis of matter. It is worth noting that the atomic/corpuscular hypothesis of matter played no actual role in the major developments of modern chemistry throughout not only the rest of the seventeenth century (i.e., post-Boyle) but also the entirety of the eighteenth century – as evident, above all, in the scientific work of the late-eighteenth century French chemist Antoine-Laurent Lavoisier, whose principal concept of 'elements' made no reference to the notion of 'simple ... atoms' (Brock 1992: 129).

To begin with, the phenomenon of chemical combination was concerned with how different types of chemical elements combined with each other to form a particular sort of compounded substance in precise (or definite) proportions. For instance, the phenomenon was about how, say, the natural substance of water came to be formed as a result of the way its two known

constituent elements – hydrogen and oxygen – combined with each other in precise (or definite) proportions (Chalmers 2009 and Gardner 1979). As an explanation of how this occurred, Dalton hypothesised that since all matter was composed of basic, indivisible and indestructible units – known as 'atoms' – then it followed that all the different chemical elements of nature were able to combine with each other to form specific sorts of compounded substances in precise (or definite) proportions because they were made up of atoms themselves. In other words, the phenomenon of chemical combination was the result of atoms bonding with each other (Chalmers 2009 and Gardner 1979).

The apparent evidence for this type of atomistic explanation was provided by the 'relative weights' of each of the elements which made up the different compounded chemical substances. Specifically, this was done by assuming that each of the elements which made up the different types of chemical substances were comprised of the same amount (or number) of atoms and then weighing them in relation to one another. As a result, it was possible to determine – as far as Dalton was concerned – the weight of one element against the weight of the other (i.e., the heaviest against the lightest). Hence, for Dalton, the empirical evidence for the existence of atoms.

The significance, then, of Dalton's scientific work at this stage in the history of modern natural science was that it attempted to not only offer a purported explanation of a particular chemical phenomenon in terms of the atomic hypothesis of matter but also, importantly, provide some possible (or reasonably acceptable) evidence for the existence of atoms. Indeed, to put all this in Lockean terms, Dalton had attempted to explain the nominal essence of chemical things in terms of their purported real essence.

However, while this was the case, it was generally accepted at the time that Dalton's scientific work was by no means an absolute demonstration of both the existence of atoms and the truth of the atomic hypothesis of matter – principally because the relative weights of the so-called atoms themselves could not be properly determined in any testable way (Gardner 1979). On this point, Pullman (1998: 199) says that Dalton himself was aware of this fact about his own scientific achievements regarding the atomic hypothesis of matter: 'For Dalton, this … strongly suggested a corpuscular [i.e., atomic] structure of matter, even though it did not constitute definite proof'. As a consequence, the atomic hypothesis of matter was viewed by the general scientific community as providing nothing more than a useful summary of such empirical facts as the constant combining of many different elements into various types of chemical

compounds (e.g., water). As quoted by Gardner (1979: 4): '"the chemical theory of definite proportions, usually called the Atomic Theory... thus... enabl[ed] the student [according to Humphrey Davy] to deduce an immense number of facts from a few well-authenticated, accurate, experimental results."' So, once again, to put all this in Lockean terms, Dalton had only succeeded in providing a useful means by which to summarise things at the level of nominal essence; hence, he had not provided an acceptable account of this (or any other) particular chemical phenomenon in terms of its purported real essence – that which causally explains the nominal essence of things.

Thus, the prevailing state of natural science at the beginning of the nineteenth century was one which reflected that it was not really possible (at least at that stage, given where chemistry was at) to know much about the natural world in terms of its so-called real essences (such as the purported atomic make-up of matter).

Admittedly, in this account of Dalton's atomic theory of chemical combination, I have left out any references to and/or discussions of the contributing work of William Prout (the formulator of the law of constant composition or definite proportions), Joseph Louis Gay-Lussac (the formulator of the law of combining volumes) and Amedeo Avogadro (the formulator of the hypothesis or law that equal volumes of gases contain or are comprised of the same number of particles or molecules, when measured at the same temperature and pressure) to the further development of the atomic hypothesis of matter. Although I have done this, I shall nonetheless refer later on to the hypothesis of Avogadro's, specifically to what is known as Avogadro's Number (N), as it was of central importance in establishing not only the reality of molecules (and the atoms which make them up) but also the truth of the atomic-molecular explanation of the phenomenon of Brownian motion.

Notwithstanding, however, this historical fact about modern natural science, I shall now turn to a particular episode within the history of modern natural science which, by the start of the twentieth century, had clearly established (i.e., beyond reasonable doubt) that real essences are knowable (or discoverable) by natural science. This particular episode focuses on the phenomenon of Brownian motion and its explanation in terms of the kinetic behaviour of the atomic-molecular make-up of matter.

2.2.2 The phenomenon of Brownian motion (or movement) and the Einstein-Perrin proof of the atomic-molecular hypothesis

I shall now show, as Chalmers (2009: 1) points out, that the existence and/or reality of the atomic-molecular make-up (or structure) of matter is established, not by any '*a priori* philosophical argument[s]', but by the theoretical and experimental work of an *empirical* science. And moreover, this is what, crucially speaking, convinces even the staunchest sceptic (and hence critic) of the atomic-molecular theory of matter to accept not only the existence/reality of atoms and molecules but also their explanatory causal role in various accounts of the material phenomena of nature (e.g., chemical combination, Brownian motion, and both the blueness and redness of the sky (Pais 1983: 100-3)) - as well as reconciling the hypothesis itself with the second law of thermodynamics.

2.2.2.1 The phenomenon of Brownian motion (or movement): at the Lockean level of nominal essence

To begin with, Brownian motion (as discussed both by Miller 1987 and Pais 1983) refers simply to the phenomenon that was observed by the early nineteenth century botanist, Robert Brown, through a microscope in 1828. What Brown observed was that, when looking microscopically down at a specimen containing a dilute solute of pollen grains (i.e., minute particles) suspended within a liquid solvent, these pollen grains were in fact moving about in a random (or irregular) but continuous way. Hence, Brownian motion (as it is called after its initial discoverer) is nothing but the zigzag movement of microscopic particles within (in this case) a liquid solvent. It ought to be noted that Brownian motion is really the zigzag movement of *any* microscopic particles within *any* fluid solvent, whether it be in the form of either a liquid or gaseous state of matter.

It needs to be pointed out here that this empirical phenomenon is something which is at the Lockean level of nominal essence. This is simply because it is something which, to use Locke's way of putting it, can be perceived via our senses (albeit by the aid of an ordinary microscope) and, as a result, we can have ideas of in the same way as we can have ideas of any perceptible (or observable) thing, which are of a more macroscopic size.

According to Brown himself, the zigzag movement of these microscopic particles was due (as he first thought) to some specific force possessed by living matter – a force which, as Miller (1987: 475) says, gave all forms of living matter the 'vitality' to move about on their own accord (i.e., without any external force being exerted on them). But this explanation was soon

rejected by Brown after he had examined that even non-living particles (e.g., tiny 'inanimate' bits of 'chalk scrapings' (Miller 1987: 475), or anything else, for that matter, such as 'tiny fragments of fossilized wood... tiny particles of window glass, and even dust from a stone that had been part of the Sphinx' (Fowler 1998: 1)) behaved in a similar fashion.

In consequence, these particular observations of Brown's led him to draw no definite conclusions about the actual causal origins of the random (or irregular) but constant movements of these various minute particles ('Brownian particles', if you like) which were suspended in a liquid solvent, even though it was clear that something must have been causing the phenomenon of Brownian motion to occur. Throughout his discussion of this episode in the history of modern science, Miller (1987) puts great stress on this point about there being an actual causal factor behind the phenomenon of Brownian motion. I now turn to a consideration of a central scientific hypothesis that was put forth in the mid-nineteenth century to account for the possible causal origins of Brownian motion.

2.2.2.2 The kinetic theory of gases: at the Lockean level of real essence

First, let me further clarify the observable features of Brownian motion regarding some of its other uniformed and/or regular behaviours (i.e., in addition to the fact that the microscopic particles of Brownian motion move in a constant zigzag fashion) (Miller 1987: 475; and Pais 1983: 93).

The first has to do with the fact that the random movement of these various tiny Brownian particles (whether they be of a living or non-living sort) remained constant in relation to the specific temperature level of the liquid solvent in which they were suspended. In other words, their movement would become more rapid as the temperature level of the liquid solvent increased, and conversely their movement would become slower as the temperature level of it decreased. The second has to do with the inverse effects of the viscosity of the medium of the liquid solvent itself on the tiny Brownian particles; these particles would *either* decrease in their movement as the result of the growing viscosity of the liquid *or* increase in their movement as the result of the diminishing viscosity of the liquid.

These two particular aspects of Brownian motion suggested that there was no other physical factor – apart from them – involved in affecting the movement of these tiny Brownian particles within a liquid solvent. Of course, one hastens to add, they did not in themselves provide any explanation (of a causal type) for the phenomenon of Brownian motion itself; rather, they simply elaborated on the observable features of it.

In his discussion of these aspects of Brownian motion, Miller (1987: 474-5) uses the term 'produces' here; however, I think this is too strong a term to use as it might suggest that they are the primary causal factors rather than being important contributing (or secondary) ones involved in the random but constant movements of these tiny Brownian particles. Also, Miller wants to single out temperature as the only 'physical factor' involved here in their movement. Yet, this cannot be the case since he talks about two physical factors – the temperature and viscosity of the liquid medium in which tiny Brownian particles are suspended. At any rate, this is what I think he should be saying given how he puts things in the text of his book.

I shall now show in what way the kinetic theory of gases was considered as providing a genuinely possible causal explanation of Brownian motion.

First, an account of the kinetic theory of gases itself. In sum, this theory held that a body of gas is comprised of an infinitely large number of very small molecules (i.e., sub-microscopic particles) which are not only in perpetual motion but also move at a constant speed or rate due to a constant temperature (Silver 1988: 24). As a consequence, this meant that the molecules of any sample of gas would either speed up or slow down in direct relation to the rise or fall of the temperature of the gas. So, the kinetic behaviour of gases, i.e., their motion, would reflect the level of their relative temperature. For example, gases which were of a higher temperature than other ones would result in, and be reflected by, a higher kinetic level in terms of the rapid movement of its molecules than those of the other ones which had a lower temperature.

Thus it was on the basis of this particular theory about the kinetic behaviour of gases that the phenomenon of Brownian motion was to be accounted for, i.e., causally explained. This was especially the view held by *both* the Italian physicist Giovanni Cantoni *and* the two Belgium physicists Joseph Delsaulx and Ignace Carbonelle, as can be seen in their respective statements. Firstly, as Cantoni says: 'I believe that the dancing motion of the solid particles ... can be attributed to the different velocities which ought to be ascribed ... either to the said solid particles, or to the molecules of the liquid which hit [these solid particles] from all directions' (Pais 1983: 93). And secondly, as Delsaulx says on behalf of both Carbonelle and himself: 'In my way of considering the phenomenon, the Brownian motion should be the consequence of the molecular heat motions of the ambient liquid' (Pais 1983: 93).

What is being claimed here is that the purported cause of the phenomenon of Brownian motion is due to 'the internal motions of the [liquid] fluid', i.e., the zigzag motion of microscopic particles occurs as the result of being bombarded or hit from all sides by the presence of rapidly

moving sub-microscopic particles (i.e., things that are too small to be seen even by the aid of a powerful microscope) (Pais 1983: 93). In short, this is what follows, if the kinetic theory of gases is true, especially if all other possibilities for a causal explanation of Brownian motion, such as 'temperature gradients, mechanical disturbances, capillary actions... and the presence of convection currents within the liquid [solvent]' (Pais 1983: 93), are ruled out for sound scientific reasons.

Accordingly, what we have here is a purported causal explanation of the phenomenon of Brownian motion which is at the level of what Locke calls a real essence.

Despite this, it was not an explanation which was readily accepted at the time. This is because there were some serious doubts about the scientific status (or plausibility) of the kinetic theory of gases itself, especially in relation to the second law of thermodynamics.

The second law of thermodynamics (which, like all laws of nature, is based on observation and/or experimental data (Silver 1988: 222)) simply states that heat, for instance, always moves (or flows) from a hot state to a cold state (a state known as entropy or disorder). This means, consequently, that heat (for instance) cannot flow spontaneously back from a cold to a hot state (Mahan 1965: 281). Significantly, then, the implication of the second law of thermodynamics is that such natural processes, as evinced by the example of heat, are essentially irreversible – when left to their own natural devices and no interventions have occurred to change the flow or direction of their thermodynamic behaviour (Mahan 1965: 281).

With respect to the kinetic theory of gases, the objection was this: since the second law of thermodynamics was an established truth, which most scientists accepted, then how could there be 'mechanical motion' of a sort which indicated that there was a spontaneous increase rather than a decrease in their kinetic behaviour? In other words, was not this proposition of the kinetic theory of gases simply in breach (or violation) of the truth of the second law of thermodynamics, since it attributed some type of spontaneous reversible behaviour to gas molecules? For those scientists, such as Henri Poincaré, Wilhelm Ostwald and Ernst Mach, it was. As a consequence, they (and others that agreed with them) rejected the kinetic theory of gases on the grounds that it was basically implausible in light of the fundamental empirical truth of the second law of thermodynamics. The exception was Ludwig Boltzmann, however, for whom the second law of thermodynamics was nothing more than a manifestation of what was actually occurring at the sub-microscopic level of matter (Pais 1983: 72-3).

In addition, they also rejected the existence and/or reality of the sub-microscopic particles of matter (atoms and molecules) on which the kinetic theory of gases was predicated. The reason was that, as far as these prominent scientists were concerned, there was no substantial experimental evidence (or proof) of their actual existence.

The upshot of this was that the kinetic theory of gases was, therefore, no plausible basis on which to mount a causal explanation of Brownian motion. In other words, despite the views of, say, Cantoni, Delsaulx and Carbonelle, the zigzag movement of the microscopic, Brownian particles was not to be causally explained (or accounted for) in terms of the apparent kinetic behaviour of the so-called sub-microscopic particles of matter (in this case, gas molecules). Instead, all that could be said for it (as was the specific view held by Poincare, Ostwald and Mach, at the time) was that the kinetic theory of gases was nothing more than a heuristic device for both (a) the summarisation and systemisation of the observational data of Brownian motion and (b) the prediction of its various behaviours and features. Indeed, the general view of the kinetic theory of gases (on their part) was that it was merely a heuristic device for both (a) the summarisation and systemisation of *all sorts* of observational data and (b) the prediction of the behaviours and features of *all sorts* of observable things.

So, from a Lockean perspective, it can be concluded that, contrary to the views of some scientists of the time, the so-called real essences were not in fact knowable. As a result, scientists were still compelled to operate at the Lockean level of nominal essences in terms of their physical and chemical investigations of the natural world. At most, all they could do is speculate about the possible real essence of things, such as Brownian motion.

While this might have been a reasonable view for scientists in general to have held at the time, it could no longer be sustained (except by some recalcitrant scientists like the physicist Ernst Mach, as Miller (1987) points out, largely because of his underlying commitment to some kind of positivism) given both the theoretical investigations of Albert Einstein and the experimental proofs of Jean Perrin in relation to establishing that the only viable scientific explanation of Brownian motion was in terms of the kinetic behaviour of the atomic-molecular make-up of matter.

2.2.2.3 Proof of the correctness (or truth) of the atomic-molecular explanation of Brownian motion (or movement)

As I shall now show, the atomic-molecular hypothesis of matter provides, at the Lockean level of real essence, a causal explanation of the phenomenon of Brownian motion (or movement), i.e., something which occurs at the observable Lockean level of nominal essence.

To begin with, I present Einstein's theoretical account of Brownian motion in his 1905 paper, which is entitled "On the Motion Required by the Molecular Kinetic Theory of Heat, of Particles Suspended in Fluids at Rest". Einstein did not initially set out to explain the specific phenomenon of Brownian motion itself. Instead, what he really wanted to do was to establish (or prove) the actual existence and/or reality of atoms and molecules, which were held to be the basic constituents of all matter. For in doing so, he would thus provide the necessary theoretical proof (or evidence) which would justify the use of the atomic-molecular theory of matter in various explanations of all sorts of natural phenomena. Yet, despite this, his theoretical work nonetheless bared directly upon the problem of how to explain the phenomenon of Brownian motion. Indeed, Einstein was somewhat aware of this himself, given his comments in his 1905 paper, wherein he says: 'It is possible that the motions discussed here are identical with the so-called Brownian molecular movement ...' (Pais 1983: 94). In doing so, it will be seen that there are two interrelated aspects to Einstein's 'theoretical proof' of the atomic-molecular account of Brownian motion: on the one hand, a qualitative proof and, and on the other, a quantitative one.

Einstein's basic argument (in a nutshell) is as follows: the atomic-molecular hypothesis of matter, which is meant to provide a causal explanation of how microscopic particles, suspended within a liquid solvent, move about in a zigzag fashion, is true (or correct) if 'osmotic pressure due to Brownian motion exists' (Miller 1987: 475). In other words, 'osmotic pressure ... is evidence' for not only establishing the truth of the atomic-molecular hypothesis of matter itself but also, in this particular case, as providing a correct scientific explanation for the phenomenon of Brownian motion as well (Miller 1987: 475). I shall first start with Einstein's qualitative argument or proof.

Einstein's qualitative proof runs as follows by drawing an analogy with the natural process of osmosis (Fowler 1998: 1). Osmosis is the process wherein, say, a body of water passes through (or across) a membrane from a dilute to a more concentrated region, such as from fresh water to salt water (Summerlin 1981: 164-6). For this to happen then what is required is that the

membrane in question be one which is semi-permeable, i.e., it is perforated with very tiny holes. These very tiny holes must be sufficiently small enough, however, to allow only component parts (i.e., molecules) of water to pass through them and not anything else, such as the component parts [i.e., molecules] of sea salt. So, when a container, for instance, is divided up into two halves in which one half is comprised of fresh water and the other is full of sea water, and a semi-permeable membrane is introduced (i.e., by removing its non-permeable cover), then what will subsequently occur is that water from the fresh water side (i.e., the dilute part) of the container will flow into the salt water side (i.e., the more concentrated part). As a result, the level of the salt water side will initially increase (or rise), which in turn means that the level of the fresh water side will decrease (or drop). However, afterwards, the level of salt water will drop back down (decrease) to a certain level, which in turn means the level of fresh water will once again rise back up (increase) to a certain level. This will essentially occur because of a phenomenon called *osmotic pressure*, i.e., 'the pressure required to counteract osmosis' – which means, in other words, the pressure which builds up on the more concentrated side of the container (the salt water part) to prevent all the water flowing from the dilute side of the container (the fresh water part) into it. In short, it is a kind of counter-balancing force exerted within the more concentrated part of the container in question. Importantly, as a consequence, the level of the salt water part of the container will always be somewhat higher than the level of its fresh water part. The reason for this is because both sides of the container will contain equal volumes of what is in fact fresh water. So, to be more precise, what you will actually have is one side comprised of exactly half of the fresh water (fresh water part) and the other side composed of exactly the other half of fresh water plus its salt content (salt water part).

Now, when one turns to the phenomenon of Brownian motion itself, one can observe a similar osmotic process, according to Einstein. This is so if the following thought experiment is carried out. If you divide a horizontal cylindrical container into two parts by a covered-up semi-permeable membrane, wherein one part of its liquid solution contains microscopic particles (e.g., pollen grains) which are too large to pass through the very tiny holes of the semi-permeable membrane and the other part is simply the liquid solution itself (i.e., it is comprised of nothing else but what makes it up in terms of its particular molecules, which in turn are small enough to pass through the tiny holes of the semi-permeable membrane); if, furthermore, you ensure that the horizontal cylindrical container is insulated from all external forces which might affect it, except the only one it cannot be – gravity (Miller 1997: 475); if, furthermore, the semi-

permeable membrane is allowed to act like a piston, i.e., something which moves back and forth under pressure; and if, furthermore, you remove the cover from the semi-permeable membrane of the horizontal cylindrical container, then the following observable phenomenon will occur. First, it will be observed that the semi-permeable membrane has moved. Second, the side on which the microscopic particles (pollen grains) are contained it will be observed how they initially increase before settling back to a volume of fluid which is still greater than the volume of fluid which is made of nothing else but the molecules of the liquid solution itself. And third, it will be observed that the microscopic particles of pollen grains have not dropped to the bottom of the horizontal cylindrical container due to the force of gravity but have, rather, continued to move in a constant zigzag way.

For Einstein, all these observable things can only happen if 'osmotic pressure due to Brownian motion exists'. In other words, when the molecules of the liquid solution move through the semi-permeable membrane of the horizontal cylindrical container – presumably because they are small enough to pass through its very tiny holes – to initially fill up the side with the pollen grains and as a result force the semi-permeable membrane (the piston) to move to one side before it moves slightly back to a settled position – wherein both parts of the liquid solution are held in equilibrium with each other – then this can only have occurred as a consequence of the pollen grains exerting a backward pressure on the molecules of water themselves from not completely filling up its side of the horizontal cylindrical container. In short, osmotic pressure has taken place because of the motion of Brownian particles.

Since osmotic pressure occurs because of Brownian motion, then for Einstein this establishes the existence and/or reality of particles which are too small to be seen even under a very powerful microscope. In short, osmotic pressure establishes for Einstein the reality of molecules, i.e., particles of matter which are at the sub-microscopic level.

Significantly, as a result of this, Einstein also provides a theoretical basis with which the phenomenon of Brownian motion can itself be causally explained. That is to say, the constant zigzag movement of the microscopic particles (like pollen grains), which are suspended within a liquid solvent, are to be causally explained, according to Einstein, by the kinetic behaviour of the molecules themselves making up the liquid solvent. In other words, since all molecules are in perpetual motion according to the kinetic theory of gases, then what causes these microscopic particles to move about in a constant zigzag way is because they are in fact being

perpetually bombarded or hit from all sides by these much smaller, sub-microscopic particles of matter – molecules.

In addition to this qualitative proof of Einstein's, he also develops a quantitative one. In brief, Einstein does two things here. First, Einstein works out a method for deriving a quantitative measurement (or estimate) of 'the exact number and size of atoms (or molecules) in a solution' that is in accordance with Avogadro's Number (that equal volumes of gas contain equal numbers of molecules). And second, Einstein develops a statistical method for calculating the exact number of times any microscopic particle will be hit by the number of molecules making up any gram of gas.

The significance, then, of the quantitative component of Einstein's theoretical work is that it provided a means by which to experimentally confirm, once and for all, the reality of atoms and molecules, and the subsequent truthfulness of the atomic-molecular hypothesis of matter.

Let us now turn briefly to Perrin's experimental proof of the atomic-molecular explanation of Brownian motion. Basically, Perrin devises a series of experiments in which he is able to not only consistently derive an exact determination of Avogadro's Number but also calculate the precise number of times any microscopic particle will be hit by the number of molecules making up any gram of gas – and, moreover, the actual distances they travel and the time in which they do so (Pais 1983: 95-100). He does this, basically, by preparing, with great exactitude, 'a set of small spheres which are nevertheless huge compared with simple molecules' and placing them within a liquid solvent, whereupon he used 'a stopwatch and a microscope' to 'find Avogadro's number' (Pais 1983: 97). As a consequence, Perrin (later on) declared:

> The atomic theory has triumphed. Until recently still numerous, its adversaries, at last overcome, now renounce one after another their misgivings, which were, for so long, both legitimate and undeniably useful.
>
> (Miller 1987: 474)

It is the received view in the literature that the quantitative aspects of Einstein's overall theoretical analysis of Brownian motion constitute the truly crucial part of the case for proof of the reality of atoms and molecules (Pais 1983: 95-100).

In consequence of Perrin's experimental proof of the atomic-molecular explanation of Brownian motion, which in turn supported Einstein's own initial theoretical investigations of

it, it was no longer possible for anyone within the broad scientific community to deny what had been proved beyond any reasonable doubt, as illustrated by the following comments of two hitherto sceptics about the truth of the atomic-molecular explanations of matter.

First, this is what was said by Ostwald:

> *I have become convinced that we recently came into possession of experimental proofs of the discrete or particulate nature of matter, proofs which the atomic hypothesis vainly sought for centuries* ... The separation and measurement of ionized gases, on the one hand, which the long and splendid researches of J. J. Thomson have crowned with complete success, and, on the other hand, the agreement of Brownian motion with the demands of the kinetic hypothesis, which was established by a series of investigators, finally and most completely by J. Perrin, justify even a cautious investigator in speaking of an experimental proof of the atomic nature of extended matter.
>
> (Miller 1987: 474)

Then, this is what was later said by Poincaré:

> the atomic hypothesis has recently acquired enough credence to cease being a mere hypothesis. Atoms are no longer just a useful fiction; we can rightly claim to see them, since we can actually count them ...
>
> (Pullman 1988: 256)

That is to say: 'The atom of the chemist is now a reality' (Miller 1987: 474).

As Pais (1983: 99) points out, Perrin, in his own account of the experimental work he did on Brownian motion, provides 'not only an account of the determination of *N* [Avogadro's Number] from Brownian motion but also a summary of all methods for determining *N* which had been put to the test at the time'. This is also endorsed by Einstein himself : "'I had believed it to be impossible to investigate Brownian motion so precisely'" (Pais 1983: 99).

Given the Einstein-Perrin proof of the reality of atoms and molecules, which in turn provided the evidence to validate the atomic-molecular hypothesis of matter, it is clear that knowledge at the Lockean level of real essence is actually possible. Furthermore, it is on the basis of this type of knowledge that natural science (as at least exemplified by the atomic-hypothesis of

matter) can subsequently provide a causal explanation of things which occur at the Lockean level of nominal essence (as illustrated by the phenomenon of Brownian motion).

It should be noted that, as far as Einstein was concerned with respect to the issue about whether the second law of thermodynamics undermined an atomic-molecular account of reality, he had this to say: 'Because of the understanding of the essence of Brownian motion, suddenly all doubts vanished about the correctness of Boltzmann's interpretation of the thermodynamics laws' (Pais 1983: 100). In other words, both Einstein's and Perrin's proof of the atomic-molecular explanation of Brownian motion upheld Boltzman's position that the second law of thermodynamics (as interpreted as indicating nothing more than that 'entropy increases almost always, rather than always') was compatible with 'the particulate [i.e., atomic] structure of matter' (Pais 183: 82). Consequently, the view of Planck's, for instance, that the 'consistent implementation of the second law [i.e., to Planck, increase of entropy as an absolute law] ... is incompatible with the assumption of finite atoms' (Pais 183: 82), was no longer sustainable. Hence, the major theoretical objection to the atomic-molecular account of matter was, in the end, baseless.

As noted in the literature, the atomic-molecular hypothesis also explains many other natural phenomena, from the combination of chemical elements through to the blueness of the sky (Pais 1993).

2.2.6 Conclusion

Given the history of modern natural science, Locke's account of how essences are the unknown basis of phenomena is ultimately refuted by what natural science has actually revealed about the physical and chemical phenomena of the natural world – i.e., at the Lockean level of real essences. Specifically, that they are all comprised of atomic-molecular matter, which in turn accounts for their various sorts or kinds of manifestations, or observable features – such as how the manifested or observable qualities of copper are due to 'a collection of atoms each with a definite and identical internal structure', or the substance of water is the result of the way two hydrogen atoms combine or bond with one oxygen atom to form a basic water molecule, and as a result exhibit all of its known properties and behaviours (Harré and Madden 1975).

Nonetheless, Chalmers (2007 and 2014) makes the pertinent point that even though by the early stages of the twentieth century (to be precise, by the Solvay Conference of 1911) the atomic-molecular hypothesis of matter had been firmly established as a result of the scientific work done on Brownian motion, it should not be assumed that such a hypothesis (as both formulated

and understood at the time) was beyond either rebuke or improvement (i.e., further development). The theory, as it stood at the time, only reflected what Chalmers calls a weak version of atomism: a version which claims nothing more than that 'the properties of macroscopic matter arise as a result of the combinations and motions of tiny particles'. Consequently, it cannot be claimed that a stronger version of atomism had been established – one which holds that 'all the macroscopic properties of matter' are explained 'in terms of underlying particles with specified properties and governed by specified laws' (Chalmers 2014: 23); in short, a quantum mechanical account (Chalmers 2007: 1).

2.3 Reflections on the role of Locke's empiricism in his account of essences as the unknown basis of phenomena

Before concluding this chapter, I shall consider the question about how much weight should be attributed to Locke's empiricism, specifically, his empiricist theory of ideas, regarding its possible role in hindering a proper development of a scientific realist account of phenomena.

So far, what has been established in this chapter is that the principal reason for Locke's inadequate account of essences as the unknown basis of phenomena is that it was based on the metaphysical speculations of the natural philosophy of his times. Given this, does it mean that Locke's empiricism is off the hook? My answer, in short, is yes and no.

Locke's empiricism is off the hook if all he is trying to do in the *Essay* is to present an account of how we come to have perceptions and ideas of the sensible qualities of external objects (such as their colours, sounds, tastes, etc.) via what he took to be the best available physical hypothesis of the science of his times: the corpuscular hypothesis of matter. That is, it is not Locke's fault that the science of his times was unable to do any better than it did in attempting to causally explain phenomena on the basis of the so-called primary qualities and combinations of the basic units of matter (atoms/corpuscles). However, since the corpuscular hypothesis of matter was at least in principle a preferable hypothesis to the prevailing alternative – the Scholastic Doctrine of Substantial Forms – it made sense that he appealed to it, otherwise he would have had nothing to help him plausibly explain the kind of phenomenon he was interested in explaining: our perceptions and ideas of the sensible qualities of external objects.

Although it is logically possible to suppose the existence of real essences, it does not necessarily follow that one can actually know these real essences and give a good account of how they determine nominal essences. For instance, in the case of Boyle's corpuscularian

hypothesis of matter, while he might have had some good reasons for supposing the actual existence of the corpuscular (or atomic-molecular) structure of things, he nonetheless lacked an adequate account of what they were and how they determined the observable properties of things. Given the then progress of Boyle's corpuscularian hypothesis of matter, which (as just characterised) displays certain but crucial limitations, it is not surprising that Locke held a sceptical view about the knowability of real essences. In other words, Locke's sceptical view about the knowability of real essences is a direct result of what Boyle's corpuscularian hypothesis of matter fails to reveal. In short, Boyle's corpuscularian hypothesis of matter does not convince Locke about the knowability of real essences.

However, Locke's empiricism is not off the hook in the sense that it constrained the way he actually conceptualised the basic units of matter. That is, Locke conceived atoms as nothing more than 'miniature inert stones' and corpuscles as nothing more than clusters of 'miniature inert stones'. That is, in ontological terms, Locke treated (just like Boyle and Newton did) these basic units of matter as if they literally looked like and behaved like observable stones. As a consequence, Locke projected onto the basic units of matter the perceptible qualities and properties of external physical objects. Of course, in doing so, Locke (just like Boyle and Newton) simply assumed that there was some sort of continuum between the qualities and properties of observable external objects (like pieces of inert stones) and the qualities and properties of the basic units of matter. Now, the problem with this type of empiricist conception of atoms and/or corpuscles is that it overlooks the possibility that the basic units of matter are fundamentally different in their actual structure to the way macroscopic objects of observation appear, as has been borne out by a quantum mechanical account of atoms, wherein atoms are no longer conceived as 'miniature inert stones' but rather as composed of a nucleus made-up of protons and neutrons with electrons spinning around them in accordance with the principles of quantum mechanics. So, on the basis of his empiricist theory of ideas, Locke presents what may be called a 'billiard ball' conception of the basic units of matter. As a consequence, the type of realism he ascribes to these basic units of matter is a commonsense one rather than one that transcends the perceptions and ideas that we have of the sensible qualities of external objects. So, in this sense, Locke's empiricism does indeed hinder to some degree how we might conceptualise the make-up of atoms, which are the basic units of matter.

Now, on this note, I used to think, like Kornblith (1993), that Locke's empiricist theory of ideas was the ultimate source of his failure to give a full-blown scientific realist account of phenomena. However, I now think that Locke's empiricist theory of ideas is only responsible

for giving a limited conception of the make-up of the basic units of matter. In that sense, at least, it should be critiqued. As we have seen in the previous chapter, Locke's empiricism can in fact be a basis for a scientific realist trend in the philosophy of science. However, if it is to be ably supported then it needs to be buttressed by the theoretical and experimental work of modern natural science, as evinced in the Einstein-Perrin proof of the atomic-molecular structure of matter. Consequently, it cannot be based on the metaphysical speculations of the natural philosophy of Locke's times, as found in the mechanical theories of Boyle and Newton. For if it is, then it is opened to the sort of criticism (as we shall see in the next chapter) that Hume would make against it – if your 'ideas' of the essences of phenomena are not based on any 'impressions' of them, then you cannot claim to know anything about them.

2.4 Conclusion

So, the overall conclusion of this chapter is that (1) the main problem of Locke's account of essences as the unknown basis of phenomena is that it is based on the metaphysical speculations of the natural philosophy of his time rather than simply his empiricist theory of ideas. And that (2) it is indeed possible for natural science to reveal the essences of phenomena as epitomised in the Einstein-Perrin proof of the atomic-molecular structure of matter, if it employs the theoretical and experimental methods as seen in the respective scientific practices of both Einstein and Perrin.

3

Hume's empiricism as the foundation of positivism: the hidden essence discarded as unknowable

3.0 Introduction

The aim of this chapter is to establish that Hume's empiricism is the epistemological foundation of positivism. Hume's empiricism is the epistemological foundation of positivism because all positivists from Mach through to Poincaré, Duhem and the logical positivists (to just name the most prominent ones) accepted not only Hume's account about the basis of knowledge – that all our knowledge is ultimately based on experience and observation – but also Hume's overall account about the limits of knowledge – that all our knowledge is limited to what is observable on the basis of experience. They thus all accepted the sceptical conclusion of Hume's philosophical account of cause and effect relations: since we can have no knowledge of the 'essence and construction of bodies' (their causal powers) on the basis of experience and observation, we are consequently unable to know how certain objects or events are necessarily connected to each other as 'causes' and 'effects' (Hume 1985a: 440 and 660). They therefore all accepted that all cause and effect relations are, as Hume claims, just instances of actual constant conjunctions – i.e., instances of how certain 'causes' (like the striking of a white billiard-ball) are always joined together with certain 'effects' (like the sudden movement of a black billiard-ball after being struck by the white one). These positivists thus developed the following specific view about the aim of science: since it is impossible to know anything about the hidden essences of phenomena (their causal foundations) on the basis of experience and observation, they are to be discarded as unknowable entities. The aim of science is to discover what is actually knowable on the basis of experience and observation – the regular connections between phenomena – and, in so doing, formulate them as 'laws of nature', which in turn can be ultimately used as the basis for making predictions and/or offering explanations about certain types of phenomena. This particular view of science as articulated by positivism rests squarely on the epistemological and sceptical arguments of Hume's empiricist philosophy.

In order to establish this claim, I shall proceed broadly as follows. Firstly, I shall expound what Hume's empiricism is and how it informs his philosophical discussion about cause and effect relations (the central problem he addresses in Book I of both the *Treatise* and *Enquiries*), as well as looking at what is his overall conclusion about knowledge. Secondly, I shall tease out the 'choices' which Hume leaves us with as a result of his empiricist account of causation and point out which one the 'positivists' decided on. Thirdly, I shall show how Mach, Poincaré, Duhem and the logical positivists specifically developed their particular 'positivistic' views about the aims of science on the epistemological foundation of Hume's empiricism. And finally, I shall sum up the main features of positivism as a philosophy of science.

3.1 Hume's empiricism: impressions and ideas

3.1.1 Hume's empiricist principle: the only solid basis for scientific knowledge is experience and observation

In the introduction to the *Treatise*, Hume (1985a: xvi) says that in order to build a 'compleat system of the sciences' (of which Newton's *Principia* is the pinnacle) then it must be built on the only secure foundation available, the 'science of man'. However, in order to do this, such a science itself must be built on a solid foundation as well, otherwise the 'other sciences' will be built on shaky grounds. Science itself must be built, according to Hume (1985a: 1), on the 'only solid foundation' available: 'experience and observation'.

How does Hume set about doing this? The answer to this question is to be found in his account of the origin of 'our ideas' (Hume 1985a: 1).

3.1.2 Hume's account of the origin of ideas

3.1.2.1 Hume's account of perceptions

Hume first examines the 'perceptions' of the human mind. According to Hume (1985a: 647), perceptions are 'whatever can be present to the mind' whenever a human being is having a particular experience of something. For instance, a person may have a perception of something as the result of some sensation (seeing the colour red), or some passion (being enraged with anger), or some emotion (being overcome with sadness), or some thoughts (remembering how yesterday was a beautiful spring day).

For Hume, all perceptions can be divided up and distinguished into what he calls 'impressions' and 'ideas'. Impressions, for Hume (1985a: 1), are those perceptions which the human mind

immediately has whenever a person experiences anything in terms of their various 'sensations, passions or emotions'. Specifically, impressions are what immediately 'strike' the human mind with, as Hume (1985a: 1) says, the 'most force and violence'. Ideas, however, are those perceptions which the human mind has whenever a person is thinking about or reflecting on what one has experienced in terms of their various sensations, passions or emotions. Ideas, in contrast to impressions, are what strike the human mind with the least amount of 'force' and 'violence'. They are the 'faint images' (Hume 1985a: 1) of the various impressions which initially strike the human mind. While both impressions and ideas are deemed by Hume (1985a: 1) to be perceptions, they differ from one another relative to their 'force and liveliness' as they 'make their way' into the 'thought or consciousness' of any human being. Thus impressions are the 'lively and stronger' perceptions of the human mind, while ideas are its 'fainter and weaker' ones.

Hume also points out that our perceptions rest on another division as well between simple or complex ones; that is, they can be divided up into ones which reflect either simple impressions and ideas or complex impressions and ideas. If they are simple perceptions then, according to Hume, they cannot be either distinguished or separated into many parts. A simple perception such as seeing and thinking about the colour red cannot be decomposed into many parts (whether in terms of the impressions or ideas we have of it). However, complex perceptions can be both distinguished and separated into many parts. A complex perception such as seeing and thinking about an apple tree in the field can be decomposed into the many parts which make it up (whether in terms of the impressions or ideas we have of it).

3.1.2.2 Hume's maxim about impressions and ideas: there can be no idea of anything unless derived from an impression of it

Let us now show how Hume (1985a: 4) thus arrives at the basic maxim or 'general proposition' of his empiricist philosophy, which he uses to analyse cause and effect relations. Hume notes that there is a resemblance between the impressions and ideas we have of things, despite the fact that ideas are always, relative to impressions, fainter and weaker. Whenever the human mind has the impression of red a corresponding idea of it appears as well in the mind. Consequently, for Hume, these two different perceptions of red are in effect reflections of each other: the impression of red basically reflects the idea of red, whilst the idea of red basically reflects the impression of red.

Although, as this simple example illustrates, impressions and ideas are basically reflections of each other, Hume nonetheless points out that the problem with treating the relation between impressions and ideas in this way (as simple reflections of each other) is that it can possibly conceal the actual causal relation or connection between them. That is, which of the two is the actual cause of the other? For instance, would it be possible for anyone to have the idea of red if one has not already had an actual impression of it?

Hume's (1985a: 4) answer is:

> *That all our simple ideas in their first appearance are deriv'd from simple impressions, which are correspondent to them, and which they exactly represent.*

In order to have any ideas (i.e., simple ideas) then they must first be derived from impressions (i.e., simple impressions): hence, simple impressions are the causes of simple ideas. But what are his reasons for saying this? Hume offers what he calls two kinds of 'phaenomena' – which have their basis in experience and observation – to support his case: (1) the 'constant conjunction' of simple impressions and simple ideas, and (2) the absence of simple ideas due to the absence of simple impressions because of some sort of 'accident' to human faculties.

Regarding the first phenomenon, Hume says that whenever it is observed that there is a simple impression in the mind of someone, there will always be a simple idea as well. If red is a simple impression which the human mind repeatedly perceives via the sense of sight then there will be an idea of it too. The same principle applies with respect to any simple impression the mind might have as a result of its senses; it will always have a corresponding idea. For Hume (1985a: 4) there is thus a constant conjunction between simple impressions and simple ideas which resemble each other; in other words, there is a 'constant conjunction of resembling perceptions'. Hume (1985a: 4) therefore concludes that there is a 'great connexion' between these 'correspondent impressions and ideas'.

Hume also notes that whenever one observes these sorts of constant conjunctions, it is always the case that simple impressions precede simple ideas. It is always the case that the simple impression of red is first perceived by the human mind before there is an idea of it. Hence, such simple impressions of red will always be the cause of its corresponding idea in the minds of people.

The upshot of this first phenomenon is that it is not just the case that simple impressions always correspond with simple ideas (and vice versa), but also that simple impressions always precede

their corresponding simple ideas. Hence, the simple impression of red will not only always be found conjoined with the simple idea of it in the human mind, but moreover, it will always precede the latter (i.e., be the cause of it).

Regarding the other phenomenon, Hume (1985a: 4) says that whenever the bodily faculties of any human being is damaged through some sort of accident at birth which results in being 'born blind or deaf', then their capacity to have any simple impressions of the world will be hampered. If anyone is born deaf, then that person will be unable to have any simple impressions of such sounds as a bell ringing or a bird singing. Similarly, if someone is born blind then that person will be equally unable to have any simple impressions of such colours as red or the shape of something like the roundness of a ball. For Hume, this means that anyone who is unable to have any such simple impressions because that person lacks the requisite faculty to do so (as in the case of either a blind or deaf person), then it will be observed that same person will lack any of the corresponding ideas which would be normally associated with them. For Hume, this sort of phenomenon establishes that unless someone has the capacity to have simple impressions then that person will be unable to have any simple ideas which correspond to them. Thus, for Hume, if there is an absence of simple impressions then there will always be an absence of simple ideas.

It is on the basis of these two phenomena that Hume thus claims that in order to have any simple ideas about anything then they must first be derived from simple impressions – otherwise there can be no simple ideas of anything.

Nevertheless, there is a possible objection to this account of Hume's. It may be objected, as Hume points out, that it is not always the case that there must be an actual instance of a simple impression in order to have a corresponding simple idea of it. The example of the 'missing shade of blue' (which he cites in both the *Treatise* and *Enquiries*) illustrates such an objection. Hume presumes a situation in which a person has been acquainted with all shades of blue except one. That is, the person has had 'constant conjunctions of resembling perceptions' of all shades of blue except one. The question being raised here by this example is – is it possible for that person to have a simple idea of the missing shade of blue if that person lacks a simple impression of it? Given Hume's general proposition about how all our simple ideas are derived from simple impressions, the answer should be a categorical no. However, as Hume notes, it is quite possible for this person to have a simple idea of the missing shade of blue even though there will be no actual corresponding simple impression of it. According to Hume, that person

will be able to do so by the use of 'imagination': it will allow that person to fill in (more or less) the missing shade of blue.

Now, the point (or moral) of this example, for Hume, is that it illustrates that there may be exceptions to the general rule about how all our simple ideas are derived from simple impressions. Therefore, as far as Hume is concerned, his general proposition can on the whole still be maintained.

So, this general proposition of Hume's – that all our simple ideas are (on the whole) derived from simple impressions – is arrived at by him in the way I have just shown. It is important to note what the basic implication of this general proposition of Hume's is, so we are not left in any uncertain terms. Hume, by implication, is basically saying that unless a simple idea has its origins in a simple impression then it will fail to correspond with anything in the world of experience. Hume's mantra, then, is: *if there is no impression then there is no idea*. This mantra of Hume's, as we shall see, is really his measuring stick for determining what sorts of ideas we can and cannot have about cause and effect relations.

3.1.3. Summing up Hume's empiricism

Hume holds experience and observation to be the very (and *only*) foundations of all knowledge. It is upon such a basis, according to Hume, that we come to have the simple impressions, which in turn give rise to the simple ideas that we have about various things. Moreover, for Hume, it is in terms of these simple impressions and simple ideas that actual scientific knowledge of the natural world is to be ascertained.

3.2 Hume's account of cause and effect relations

We now look at Hume's account of cause and effect relations as based on his empiricism.

3.2.1 Distinction between relations of ideas and matters of fact

In the *Enquiries* Hume (1985b: 25) draws a distinction between two different types of 'objects of human reason': '*Relations of Ideas*' and '*Matters of Fact*'.

Relations of ideas are, according to Hume, those types of propositions which are found in the mathematical sciences (e.g., arithmetic, geometry and algebra), and which are known to be certainly true in either a self-evident or demonstrative way. For example, the propositions of arithmetic like two plus five is equal to seven, or the propositions of geometry like the combined angles of a triangle (regardless of their different geometrical shapes) are equalled to

one hundred and eighty degrees, are all known to be certainly true. This is because, as Hume (1985b: 25) tells us, they are all established simply by human reason, without any recourse to any actual existing thing (e.g., a triangular object) in the 'universe'.

The truths of the propositions which fall under the category of matters of fact – such as whether it is a cloudy day or the sun will rise tomorrow – are only ever established by whatever evidence can be used to support them. Consequently, this means that they have to be established on the basis of what is empirically the case in the world. If the sky is cloudy, then the only way to confirm this would be to observe whether the sky is actually cloudy. Equally, in order to confirm if the sun will rise tomorrow depends on observing whether it actually does so the following morning. In both cases, then, it is in terms of empirical observations, rather than by human reason alone, that such propositions are established as being true (or not). Such propositional truths can only be contingent truths.

3.2.2 All 'reasonings' about matters of fact are based on relations of cause and effect

According to Hume, all our 'reasonings' about matters of fact that go beyond evidence of immediate experience and memory are based on relations between cause and effect. For instance, whenever someone comes across a log fire, they will infer that it had been lit up by someone else. They will assume that the latter is the *cause* while the former is the *effect*. Thus all matters of fact will exhibit this particular relation between cause and effect.

For Hume (1985b: 26), the significance of this type of inferential reasoning concerning all matters of fact is that it allows us to draw inferences about them which 'go beyond the evidence of our memory and senses'.

Furthermore, as Hume (1985b: 27) points out, if all our reasonings about matters of fact were not based on some sort of cause and effect relation, which suggests some type of connection between different matters of fact (e.g., lit logs and log fire), then the particular inferences which we might draw about various matters of fact would be 'entirely precarious'. In short, our inferences about various matters of fact would be based on unfounded assumptions about what sorts of connections (if any at all) really hold between them.

Given that all matters of fact are based on cause and effect relations (i.e., causal inferences), what is for Hume (1985b: 32) the actual foundation on which we base all our 'conclusions' from the 'experience of the operations of cause and effect'? Hume offers both (firstly) a 'negative' and (secondly) a 'positive' argument.

3.2.3 The foundations of our conclusions from experience

3.2.3.1 Hume's 'negative' argument: 'reasoning'

Hume's (1985b: 32) 'negative' argument is that the foundation on which we base all our 'conclusions' from the 'experience of the operations of cause and effect' is not in terms of 'reasoning, or any process of the understanding'. To make this argument, Hume discusses the following topic concerning the 'secret powers' of objects and their 'sensible qualities' (an instance of a cause and effect relation).

Hume (1985b: 33) says that although we may be ignorant of those 'powers and principles' which cause certain objects to have particular qualities, we nonetheless presume that any object with those particular qualities – which we have seen before on previous occasions – will simultaneously possess the same secret powers; and furthermore, produce the same effects. For example, whenever we see loaves of bread, according to Hume, with the same colour (they are brown) and weight (they are heavy) – as we have seen before on other occasions – we automatically presume that these similar sensible qualities which we observe in them are the direct result of possessing the same particular secret powers (whatever they may be). In addition, when it comes to observing any of the effects of such bread, we expect to see, as Hume (1985b: 33) says, certain effects follow as a result – just as we have seen before on other occasions – such as giving 'nourishment and support' to the human body.

Although, as Hume (1985b: 33) notes here, we may presume there is some 'constant and regular conjunction' between the sensible qualities and secret powers of similar objects, there is however 'no known' connection between them which, in turn, would allow us to establish that whenever we get 'like sensible qualities' we will also get 'like secret powers'. It might be the case that one particular loaf of bread, despite the fact that it has all the same sensible qualities found in other similar loaves of bread, that this is not necessarily due to it possessing the same secret powers that those other loaves of bread presumably have; it might have a different set of secret powers which just happen to give rise to similar sensible qualities. Furthermore, with regards to the effects of such presumed conjunctions between sensible qualities and secret powers, there is no reason to assume on the basis of 'past *Experience*', Hume (1985b: 33) says, that just because certain effects happened in the past they will happen again in the future. For instance, new loaves of bread, despite appearing similar in terms of all their sensible qualities to past loaves of bread, may not necessarily produce the same effects as

they did previously: instead of nourishing and supporting the human body, they might actually harm it in some detrimental way.

Hume's (1985b: 33) point here is that what we presume to be the case – that all objects with the same sensible qualities will possess the same secret powers – and what we presume ought to follow on the basis of that particular case – that all objects with the same sensible qualities and the same secret powers will always produce the same effects – is simply based upon the 'process of the mind or thought'. In other words, these are simply suppositions which we make on the basis of some sort of reasoning.

So, for Hume, while we might want to infer, for instance, that because a particular object – which presumably always has the same sensible qualities with the same secret powers – has in the past always produced certain effects it will consequently produce the same effects again in the future, we cannot actually justify such an inference via the use of reasoning. This is because, as Hume (1985b: 34-7) says, there is no 'chain of reasoning' (or 'interposing ideas') linking such objects and their corresponding effects together. In other words, how does one get from object *A* with effects *x*, *y* and *z* to object *B* with the same effects of *x*, *y* and *z*? According to Hume, one does not.

Despite this, Hume nevertheless points out that it should not be assumed there is no foundation underpinning our conclusions about cause and effect relations. If this were the case, then why (as Hume asks) would anyone bother not learning from their past experiences? What is it that makes a child not put its hand back into the flame of a candle? The answer to these sorts of questions is given by Hume in terms of his 'positive' argument; an argument which sets out to establish what is the proper and only foundation on which to base all our 'conclusions' from the 'experience of the operations of cause and effect'.

3.2.3.2 Hume's 'positive' argument: 'custom or habit'

Hume's (1985b: 43) 'positive' argument is that all our 'inferences from experience' are the 'effects of custom [or habit]'. For Hume, 'custom' or 'habit' (and hence not 'reasoning') is the very foundation on which we draw our cause and effect inferences about the phenomena of the world. Hume (1985b: 42) argues for this claim by comparing the time when a person who, though equipped with all the 'faculties of reason and reflection', has yet to experience the world with a time when that same person has in fact experienced the world.

Regarding the pre-experience time of this person, Hume makes the following series of points. Firstly, when this person initially encounters the world, all they would immediately and only observe is not just how objects continually succeed one another but also how one event constantly follows another. Secondly, they would be unable to know anything else. In particular, they would be unable to acquire via the use of 'any reasoning' the 'idea of cause and effect' (Hume 1985b: 43). For Hume (1985b: 43), they would not be able to acquire such an idea principally because of two factors: (a) the 'secret powers' by which objects operate do not reveal themselves to the senses; and (b) just because, on one occasion, one event has preceded another, it is somehow reasonable to infer that one is the 'cause' while the other is the 'effect' and so discounting the possibility that the actual 'conjunction' between them is an 'arbitrary and casual' one. And thirdly, Hume (1985b: 43) points out that such a person, despite possessing the capacity to reason and make inferences, is never really in a position to either make conjectures about 'any matter of fact' or assume 'anything beyond what' is 'immediately present to' one's 'memory' or 'senses'.

With respect to their post-experience time, this person encounters the opposite situation. Firstly, as Hume (1985b: 43) points out, since this person has come to have some experiences of the world, they are able to observe a constant conjunction of 'similar objects or events'. Secondly, they are able to infer the existence of one type of object upon observing another type. But even though they can do this, they still cannot, Hume (1985b: 43) says, acquire on the basis of experience 'any idea' of the 'secret power' by which any object 'produces' another. In addition, they are not able to use 'any process of reasoning' to make any inferences about such 'secret powers', despite wanting to. So, if the act of reasoning is ruled out, what is the specific 'principle' – as Hume (1985b: 43) puts it – which allows this person 'to form such a conclusion' about how there must be 'secret powers' which cause one set of objects to always produce another set of objects?

According to Hume (1985b: 43), the 'principle' which 'determines' such thinking is 'Custom or Habit'. For Hume (1985b: 43), it is that particular principle which results from the 'effects' of the constant 'repetition of any particular act or operation', and which in turn 'produces a propensity' in human beings 'to renew the same act or operation, without being impelled by any reasoning or process of the understanding'. Let us elaborate on this 'principle of human nature', as Hume (1985b: 43) calls it.

What Hume is suggesting here is that whenever we observe past instances of constant conjunctions between certain objects – such as between fire and heat or ice and cold – we come to expect in the future that whenever we encounter one of the objects in question – such as fire or ice – we will also encounter the other object in question – such as heat or cold. Furthermore, we expect such constant conjunctions to reoccur in the future because they have repeatedly done so in the past. Such expectations cannot be rationally justified in anyway, but we nonetheless presume that they will continually be met (until, of course, when they are not). Our expectation of what will happen in the future is therefore based upon what we have repeatedly experienced in the past: we have become accustomed – i.e., we have developed a propensity to believe – that *A* (future constant conjunction of objects) will always be like *B* (past constant conjunctions of objects).

3.2.3.3 Conclusion

Thus, for Hume, custom or habit, rather than reasoning, is the only and proper foundation on which to draw any conclusions or inferences from the experience of cause and effect relations.

3.2.4 The idea of a necessary connection between 'causes' and 'effects'

I shall now look at Hume's specific analysis of the relation between 'causes' and 'effects'. This analysis of Hume's is based on his fundamental epistemological principle about how all our ideas are derived from impressions (and, conversely, if there are no impressions then there are no ideas). I shall first sketch out Hume's basic paradigm of a cause and effect relation.

3.2.4.1 Hume's paradigm of a cause and effect relation: the striking of two billiard-balls

For Hume, as discussed in the "Abstract" to the *Treatise*, the basic paradigm of a cause and effect relation is provided by the example of one billiard-ball striking another billiard-ball. According to Hume, whenever we observe a white billiard-ball striking a black billiard-ball, we will consequently observe the black billiard-ball move on impact after being struck by the white billiard-ball. For Hume, the striking of the black billiard-ball by the white billiard-ball is the 'cause' of the black billiard-ball moving on impact, while the moving of the black billiard-ball after being struck by the white billiard-ball is the 'effect' of such an impact. So, for Hume, this billiard-ball example illustrates what he takes to be a typical instance of a cause and effect relation. But what is Hume's actual analysis of such a relation?

3.2.4.2 Hume's analysis of cause and effect relations: the three requisite circumstances of (1) contiguity, (2) priority and (3) constant conjunction

For Hume (1985a: 649), there are three types of 'circumstances' which must feature as a part of any typical cause and effect relation, as illustrated by the billiard-ball example. They are the circumstances of (1) 'contiguity', (2) 'priority' and (3) 'constant conjunction'. Firstly, with regards to the contiguity element Hume simply means a situation in which we observe that there is close contact between the white and black billiard-balls before anything else happens, such as the black billiard-ball moving upon impact. In other words, it is observed that these two billiard-balls make actual contact with each other at a precise moment in time and space, without any noticeable 'interval' between the events of one billiard-ball striking another billiard-ball and subsequently causing it to move on impact (Hume 1985a: 649). For Hume, this is something which actually needs to occur if something is going to cause something else to happen (such as the white billiard-ball causing the black billiard-ball to move on impact). Thus, for Hume (1985a: 649), such a contiguous situation is a vital part of 'the operation of all causes'. Secondly, with regards to the priority element Hume (1985a: 649) merely means a situation in which we observe that the 'motion' of the white billiard-ball occurs prior to the 'motion' of the black billiard-ball. This is something that must happen if the white billiard-ball is to cause the black billiard-ball to move after being struck by the white billiard-ball. This is also, for Hume (1985a: 649), another necessary component 'in every cause'. And thirdly, whenever we have observed many instances of a white billiard-ball striking a black billiard-ball, we will notice that this always results in the black billiard-ball moving on impact. So, for Hume, what we come to observe on repeated occasions is another circumstance, which reflects a constant conjunction between something that causes something else to move (the white billiard-ball causes the black billiard-ball to move on impact), and something else that moves as a result of it (the black billiard-ball moves as the result of being struck by the white billiard-ball). We have, as Hume says (1985a: 649), a constant conjunction between the 'cause and effect'. This element is also an essential part of cause and effect relations. So, for Hume, in order for anything to be deemed a cause and effect relation then it will have to incorporate these three types of circumstance of contiguity, priority and constant conjunction, otherwise it will fail to meet the necessary and sufficient conditions which he has identified on the basis of pure observation.

It is notable that Mumford and Anjum (2011), for instance, dispute Hume's notion of priority. It is their view that causes do not precede effects, but rather that causes and effects

simultaneously occur together in a spontaneous way. This way of construing causes and effects is a central part of their 'dispositional' account of powers. Consequently, they also reject Hume's notion (or anyone else's notion, for that matter) of a necessary connection between causes and effects. In short, they reject any version of 'causal necessitarianism'. By the way, I am not suggesting here that Hume is ontologically committed to the existence or reality of 'necessary connections'. The point that these two authors are wishing to make is simply that the very notion of a 'necessary connection', as conceived or formulated by Hume, is in itself wrongheaded (and ditto for anyone else who subscribes to such a notion of a connection between causes and effects).

At any rate, is this all there is to an account of cause and effect relations, according to Hume? That is, are all cause and effect relations nothing else but relations of constant conjunctions between causes and effects, as Hume has just presented it? Or are there also, according to Hume, such things as 'necessary connections' between causes and effects, which in turn would mean that there are specific 'powers' in things which cause other things to be necessarily connected to them? For Hume (1985a: 656), it was certainly the prevailing view amongst some of his contemporaries: ''tis commonly supposed, that there is a necessary connexion betwixt the cause and effect, and that the cause possesses something, which we call a *power*, or *force*, or *energy*'.

3.2.4.3 The idea of a necessary connection between causes and effects: its source

Hume's answers to such questions are determined by the basic epistemological principle of his empiricist philosophy about how all our ideas of things are derived from our original impressions of them. In order to determine whether we can have any idea of an actual 'necessary connection' between a cause and an effect, Hume considers all the possible sources from which we might derive such an impression of it. According to Hume, there are at least, initially, two possible sources from which the idea of a necessary connection might be derived: an external impression based on single instances of the 'operations of bodies' and an internal impression based on single instances of the 'operations of minds'. Neither sources, for Hume, deliver the requisite impression on which to derive an idea of a necessary connection between a cause and an effect. The principal reason is that no single instance of a cause and an effect event is ever really able to supply us with any impression of a necessary connection between things; instead, they can only ever give us an impression of one thing following another.

3.2.4.4 The first possible source: an external impression

Hume first considers the 'operations of bodies' in which one external object causally acts on or affects another – such as when one billiard-ball hits another billiard-ball and causes it to move on impact. For Hume (1985b: 63), whenever we look at single instances of such a cause and effect situation, we will never 'discover any power or necessary connexion'. We will never, according to Hume, uncover a 'quality' (power) in such single instances which 'binds the effect to the cause' and, as a result, 'renders the one an infallible consequence of the other' (a necessary connection). Instead, all we will ever find in such single instances is that one object simply follows another, as seen whenever one billiard-ball moves after being hit by another. For Hume (1985b: 63), this is all that actually 'appears' in such single instances of cause and effect events to 'the *outward* senses' (like sight). This is the only kind of impression which such single instances of a cause and an effect event give us; there are no other sorts of impressions to be given. Thus, for Hume (1985b: 63), no single instance of cause and effect events can ever 'suggest the idea of power or necessary connexion'. This is simply because there is no actual impression from which to derive such an idea.

Apart from this point – which is about whether it is it possible to acquire any idea of a power or necessary connection from a single instance of a cause and effect event – Hume also makes another point – which is concerned with whether it is possible to infer a specific effect from any object which might feature in a single instance of a cause and an effect event.

Whenever we see an object for the first time, it is not possible, as Hume (1985b: 63) says, to 'conjecture' or infer 'what effect will result from it'. For instance, it is not possible to infer that when see a particular billiard-ball for the first time that it will result in the specific effect of causing another billiard-ball to move on impact or be smashed into tiny pieces (or anything else, for that matter). This is because, as Hume (1985b: 63) says, 'there is no part of matter' which, 'by its sensible qualities', ever reveals 'any power or energy' that 'could produce any thing, or be followed by any other object, which we could denominate its effect'. While an object may possess, as Hume (1985b: 63) says, the sensible qualities of '[s]olidity, extension [and] motion', which are in turn 'all complete in themselves', none of them however ever 'point out any other event which may result from them'. Just because a billiard-ball is perceived as being solid, or spherical, or full of motion, it is not really possible to detect from such sensible qualities that any of them could or would produce certain effects to happen (whatever they might be). All we can say is that these are the specific observable features of a particular object.

So, even though, as Hume (1985b: 63) says, 'one object follows another in an uninterrupted succession' – such as one billiard-ball following another billiard-ball after impact – the specific 'power or force' which 'actuates' such cause and effect events is nonetheless 'entirely concealed from us' given the fact that they do not reveal themselves in any of the sensible qualities of the objects involved. Thus, for Hume, it is not possible to derive any idea of power from a mere examination of just the object itself, as observed on any single occasion, since such an object does not provide us with any actual impression of power itself.

So, it is Hume's view here that no idea of power or necessary connection can *ever* be derived from any external impression based on single instances of the operations of bodies (external objects). What about the other possible source of an internal impression based on the operations of the mind?

3.2.4.5 The second possible source: an internal impression

When reflecting on 'the operations of our own minds', according to Hume (1985b: 63), it seems that we are always 'conscious' of some sort of 'power' in our own minds principally because of how, 'by the simple command of our will' (i.e., an 'act of volition'), we are able to either 'move the organs of our body' or 'direct the faculties of our mind'. For Hume (1985b: 63), we all seem to 'feel' that 'our will' (that part of the mind which purportedly makes decisions) has the power to 'influence' how certain things happen, such as making our legs and arms move or forming new ideas in 'our imagination'. Thus, for Hume (1985b: 63), it is from being cognizant of the 'influence of the will', as apparently exhibited in the operations of the mind, that we consequently derive the idea of power or necessary connection. But is this idea of power or necessary connection based on any valid impression? For Hume, the answer is no.

To argue his case, Hume first looks at the influence which 'our will' apparently exerts over the various organs of our body, from external organs like our legs and arms to internal organs like our liver and heart.

Hume first notes that 'our will' has some sort of influence over the various organs of the body. This is evident for Hume (1985b: 65) whenever we observe how the 'motion of our body follows the command of our will', like when our legs move after we have decided that we want to walk or run somewhere. Although we are continuously aware of this sort of apparent influence of the mind over the various motions of the body, Hume (1985b: 65) nevertheless points out that 'the means, by which this is effected', i.e., 'the energy, by which the will performs' such an 'extraordinary … operation', is something which we are not 'immediately

conscious' of. In short, we have no actual internal impression of any power in our minds which might cause the movement of the various organs of our body.

For Hume, such a claim is supported by three considerations. Firstly, it is supported by the fact that we have no actual idea of the 'principle' which supposedly unites a 'spiritual substance' (the soul) with a 'material one' (the body), and which in turn would account for how the former could possibly influence the latter, i.e., in terms of how 'the most refine thought is able to actuate the grossest matter' (Hume 1985b: 65). Secondly, Hume points out on the basis of experience that it is not true that we can move all the organs of the human body by our will or an act of volition, as illustrated by such internal organs like our liver or heart. And thirdly, Hume (1985b: 65) points out via the science of anatomy that 'the immediate object of power in voluntary motion' is not the particular organ itself which moves, such as an arm or leg, but those 'muscles, and nerves … and … minute and … unknown' parts in them – 'through which the motion is successively propagated' before manifesting itself in the actual motion of a particular organ (like a leg or arm) – which is.

Thus, for Hume, it is impossible for us to derive any idea of power or necessary connection from how the mind influences the various organs of our body. Instead, all we can claim is that when we observe inwardly how 'our will' influences the motions of our bodily organs is that one event simply follows another. In short, we can only have an idea of succession.

Hume also considers whether we can derive an idea of power or necessary connection from instances of how the mind, by an act of the will, creates new ideas. But in doing so he draws the same conclusion as before, based upon similar considerations. Firstly, Hume says that while the mind, by an act of will, can create or summon up a new idea, we are nevertheless unable to grasp how the mind actually produces such new ideas, since we have no actual consciousness (i.e., internal impressions) of them. Secondly, just like how the mind has limited command over the various organs of the body, so the mind has limited command over itself. And thirdly, Hume points out that when it comes to 'self-command' it is also to be noted on the basis of experience that our command over our own thoughts varies over time, depending on the context in which we find ourselves.

So, for Hume, just like before, it is not possible to derive any idea of power or necessary connection from any instances of the mind's influence over ideas.

It is notable that Hume (1985b: 70) also goes on to discuss the doctrine of *occasionalism*, which holds that all 'those objects which are commonly denominated *causes*, are in reality nothing

but *occasions*; and that the true and direct principle of every effect is not any power or force in nature, but a volition of the Supreme Being …'. In doing so, Hume (1985b: 70) rejects it on the grounds that since human beings are incapable of ever perceiving any power or necessary connection in the objects of nature (such as bodies and minds), then they are equally incapable of ever perceiving any 'universal energy and operation of the Supreme Being'. The point of this discussion is twofold: (1) it deals with a response which is offered when all else fails, i.e., when it is not possible to ever acquire an idea of power or necessary connection from any impression; and (2) it is also offered as a way of driving the point home that we can never really entertain the possibility of there being some power or necessary connection in the world, which in principle we could latch on to as a last resort.

For Hume, then, it simply is not possible to derive any idea of power or necessary connection from any instances of an internal impression based on the operations of minds. Instead, the only conscious impressions and, consequently, ideas which we may acquire, are those which reflect the succession of events, wherein one event (the so-called effect) follows another (the so-called cause).

3.2.4.6 An intermediary conclusion

So, for Hume, whether it is the operations of bodies or the operations of minds, neither in the end are able to provide us with any impression and, consequently, idea of the *power* which *necessarily connects* one object with another. This is largely because, as we have seen in both cases, single instances of cause and effect events do not reveal anything more than that one object is followed by another, as epitomised in the billiard-ball example. It seems that no idea of power or necessary connection can be acquired, if single instances of cause and effect events are all we have to go on. Thus, for Hume (1985b: 74), it seems that we have arrived at the following state of affairs:

> All events seem entirely loose and separate. One event follows another; but we never can observe any tie between them. They seem *conjoined*, but never *connected*. And as we have no idea of any thing which never appeared to our outward sense or inward sentiment, the necessary conclusion *seems* to be that we have no idea of connexion or power at all, and that these words are absolutely without any meaning …

Beebee (2011) contests the thesis that Hume was actually committed to the view expressed here in this particular passage from the *Enquiries*: that 'All events seem entirely loose and separate'. Whether she is right is not my real concern here. However, what ought to be borne

in mind here is that Hume uses the operative word 'seem' in this passage of his. Given this, I think that the best way of interpreting this passage of Hume's is to see what he says here as logically following from what he has already shown via his discussion of the two purported sources of our idea of power and necessary connection. Given what Hume has shown it would *seem* that all cause and effect events are *loose* and *separate*; whether they actually are, and whether Hume actually thinks they are, is not the point here. Hume is simply following through to what *seems to be* the *logically necessary* conclusion.

However, as we shall now see, this is not Hume's overall position. Hume does think we can have an idea of 'power' or 'necessary connection'. The source for such an idea is to be found in the uniformity or constancy of things in nature and how the mind comes to acquire a certain type of impression as a result: the impression of a 'customary connexion' in things. Let us look at this account of Hume's more closely.

3.2.5 The actual source

Hume first points out that whenever we consider any object or event in nature, it is not possible for us to ascertain what sort of other object or event will follow as a result in any single instance, unless it is based on experience. If we want to know whether object/event *A* will be followed by object/event *B*, then we first need to observe such things happening. While this is the only way to know how one object or event is followed by another object or event in a single instance, it is no basis on which to then form, according to Hume (1985b: 74), any 'general rule' about how all objects/events *A* which are similar will always be followed by all objects/events *B* which are similar. However, as Hume (1985b: 74) points out, if 'one particular species of event has always, in all instances, been conjoined with another', then we no longer hold back from inferring – out of custom or habit – that whenever object/event *A* occurs it will always be followed by object/event *B* (as has always happened on previous occasions). Hence, this is how we come to form a 'general rule' about how all *A's* are always followed by all *B's*. But in so doing, Hume (1985b: 75) says, we denominate one object/event the '*Cause*' and the other object/event the '*Effect*'. Thus, for Hume (1985b: 75), we 'suppose that there is' not only 'some connexion between them' but also 'some power in the one, by which it infallibly produces the other, and operates with the greatest certainty and strongest necessity'.

For Hume (1985b: 75), it seems that the method (the *only* method, in fact) by which we may acquire an idea of a necessary connection between those objects/events which are deemed 'causes' and those which are deemed 'effects' is on the basis of observing many 'similar

instances' of them being constantly conjoined together. Despite this, it does not quite capture the complete point that Hume wants to make about the actual origin of our idea of a necessary connection. For Hume, the true source of our idea of a necessary connection is to be found not in any objects or events, but in the subjective 'sentiments' of the mind.

In the *Treatise*, Hume (1985a: 165) says that the 'necessity' which we perceive in cause and effect relations is 'something' that 'exists in the mind, not in objects'. Hence, for Hume, our idea of a necessary connection is subjectively, not objectively based. Therefore, our idea of a necessary connection is not something which reflects any real feature in the world; rather, it is something which we project on to things which appear in any instance of a cause and effect relation. The following quotes illustrate these points.

Hume (1985b: 75) first says:

> ... there is nothing in a number of instances, different from every single instance, which is supposed to be exactly similar; except only, that after a repetition of similar instances, the mind is carried by habit, upon the appearance of one event, to expect its usual attendant, and to believe that it will exist.

Next, he (1985b: 75) says:

> This connexion, therefore, which we *feel* in the mind, this customary transition of the imagination from one object to its usual attendant, is the sentiment or impression from which we form the idea of power or necessary connexion. Nothing farther is in the case …

Thus, for Hume, the real (and *only*) origin of the idea of a necessary connection (and power too) is to be explained in terms of how the mind comes to *feel* that there is a necessary connection between objects or events on the basis of a *customary* experience of how all *A's* are always followed by all *B's*. If we were never to have a customary experience of constant conjunctions between similar objects or events, the mind would then never be able to have any subjective impressions of a necessary connection between them.

The upshot is that what Hume (1985b: 78) calls 'necessary connexions' are nothing but, on this account, 'customary connexions'. Thus, for Hume, the so-called necessary connections do not reflect any real connections between causes and effects but only what the mind perceives to be the case based on custom or habit.

In sum, Hume holds that the idea of a 'necessary connection' is, and can *only* ever be, based on the subjective impression which arises out of the customary experience of observing multiple instances of constant conjunctions between all objects/events *A* being always followed by objects/events *B*. This is the only source by which the mind can acquire any impression and consequently any idea of a 'necessary connection' between causes and effects. More specifically, it is the only basis on which to acquire an idea of the supposed power which is meant to necessarily connect one object with another.

3.2.6 Hume's sceptical conclusion

Given Hume's account of how we actually come to acquire the idea of a necessary connection between causes and effects, it would seem then that it is not possible for us to have any greater idea of how causes and effects are necessarily connected to each other. It would seem that all we can legitimately claim here is that we feel and so believe that there is some sort of power in objects or events which supposedly connects them together in such a way that they reflect a cause and effect relation; but, apart from this, there is nothing else which we can justifiably claim about them. For Hume, our knowledge of cause and effect relations is limited to what can be perceived based on a subjective experience of things. This thus means for Hume (1985b: 92) that those who 'believe' they can 'penetrate farther into the powers of nature, and perceive something like a necessary connexion between the cause and effect' are only denying, according to Hume, the 'conclusion' about 'human ignorance': that human beings are totally ignorant of the sort of power in things which causes one thing to be necessarily connected to another thing.

3.2.7 The ultimate reason for having no idea of a necessary connection: the unknown and unknowable 'essence of bodies'

In both the *Treatise* itself and the "Abstract", Hume (1985a: 400 and 660) suggests that the ultimate reason why 'in no single instance the ultimate connexion of any object is discoverable either by our senses or reason' is because 'we can never penetrate so far into the essence and construction of bodies, as to perceive the principle on which their mutual influence is founded'. So, it is not just that we lack any idea of a necessary connection because we have (as Hume argues) no impression on which to base such an idea. The problem is deeper than that. It is also because we have no idea of the very 'essence and construction of bodies' themselves as the result of the fact that we have no actual impression of such hidden things. Furthermore, we can have no idea of the fundamental principle which would allow us to see how objects are

necessarily connected to each other. Because of this general kind of ignorance about such fundamental principles, we are consequently unable to base our idea of a necessary connection on anything else but what the mind feels to be the case: the mind feels that there is some sort of connection between causes and effects, but it lacks any actual impression on which to base such an idea.

3.3 Hume's overall conclusion: a pragmatic view of cause and effect relations

Having presented Hume's empiricist account of cause and effect relations, let us now look at the overall conclusion which follows from it. Hume's view is that, since all our beliefs about cause and effect relations are not able to be based on any knowledge about how 'causes' and 'effects' are necessarily connected, we have no choice but to accept that our beliefs about various cause and effect events will be based only on practical considerations. Though we may not be able to know how 'fire warms, or water refreshes', we nonetheless believe that they will do so since 'it costs us too much pains to think otherwise' (Hume 1985a: 270). In short, a pragmatic view of our beliefs is for Hume the logical outcome of his sceptical philosophical conclusions concerning cause and effect relations.

In the concluding chapter of Book I of the *Treatise*, Hume (1985a: 264-5) informs us that despite the 'dis-approbation' of his own philosophical system by 'all' the 'metaphysicians, logicians, mathematicians, and … theologians' of his time, he nonetheless maintains that he can find no reason for not assenting to a stance which involves 'a *strong* propensity to consider objects *strongly* in that view, under which they appear to' him. Consequently, for Hume (1985a: 265), this means that we must assent to the following pair of principles: on the one hand, we must assent to the principle of experience, which 'instructs me in the several conjunctions of objects for the past'; whilst, on the other, we must assent to the principle of habit, which 'determines me to expect the same for the future'. These two principles combine together for Hume (1985a: 265) in order to 'operate upon the imagination' and, as a result, 'make me form certain ideas in a more intense and lively manner, than others, which are not attended with the same advantages'.

For Hume, the only way by which we may form any ideas of things is by way of the imagination forming certain ideas on the basis of experience and habit. However, such an 'empiricist' method is, according to Hume (1985a: 265-6), no guaranteed way of consistently producing correct inferences about things, even though it is an approach which must be 'implicitely

follow'd … in all its variations'. Hume says (1985a: 266) that this approach allows 'us' to 'reason from causes and effects' or 'convinces us of the continu'd existence of external objects, when absent from the senses' but it does not necessarily follow that we can always make such inferences. There may well be 'some circumstances' which, according to Hume (1985a: 266), make it impossible for us 'to reason justly and regularly from causes and effects', and which simultaneously allows us to 'believe' in 'the continu'd existence of matter'. So the upshot is that we are left with an unreliable basis for establishing consistently correct inferences about cause and effect events.

Furthermore, for Hume, this situation is exacerbated by the fact that we are unable to base any of our inferential reasoning from causes and effects on knowledge of the ultimate causal principles of phenomena. This is largely because we are totally ignorant of such principles.

As Hume (1985a: 266) states, there is '[n]othing' which is 'more curiously enquir'd after' by the mind of human beings than 'the causes of every phaenomenon'. But, in so doing, 'we' are not just 'content', Hume (1985a: 266) says, with 'knowing the immediate causes' of things – as evinced by how one billiard-ball immediately causes another to move on impact – but are also quite intent on actually discovering the 'original and ultimate principle' of things – such as what ultimately makes one billiard-ball cause another to move on impact. Specifically, in terms of cause and effect relations, it is 'our aim' to discover 'that energy in the cause, by which it operates on its effect; that tie, which connects them together; and that efficacious quality, on which the ties depends' (Hume 1985a: 266). However, as Hume (1985a: 266) points out, the so-called 'connexion, tie, or energy' is something which 'lies merely in ourselves, and is nothing but that determination of the mind, which is acquir'd by custom'. As a result, we can expect nothing more, Hume says, than that one object is usually followed by another and that an idea of one object is usually derived from the impression of another. The upshot is that all hopes of ever knowing 'the ultimate… operating principle, as something, which resides in the external object' is thus permanently 'cut … off' from us (Hume 1985a: 267).

This limit on our knowledge of the ultimate causal principle of phenomena is not something which is actually 'perceiv'd in common life' (Hume 1985a: 267). Indeed, for Hume (1985a: 267), it never seems to cross anyone's mind that in the 'most usual' instances of cause and effect conjunctions they are 'as ignorant of the ultimate principle' which 'binds them together' as they are in instances of 'the most unusual and extraordinary' ones. Instead, they just take it

for granted that all cause and effect relations are based on some sort of 'ultimate principle' which causally connects things together.

To view such things in a casual or common-sense way is, however, to simply accept what 'proceeds … from an illusion of the imagination' (Hume 1985a: 267). In consequence, this particular situation raises for Hume the following question: to what extent should such 'illusions' be yielded to by philosophers? In attempting to answer this question, Hume (1985a: 267) notes that regardless of what sort of answer is actually given, it inevitably 'reduces us to a very dangerous dilemma' – a dilemma which seems to leave us, on philosophical grounds, in an unsatisfactory state – as can be seen in what follows.

On the one hand, according to Hume (1985a: 267), if we (*qua* philosophers) do not reject such 'illusions' then we end up with the following predicament:

> For if we assent to every trivial suggestion of the fancy … [then] they [will] lead us into such errors, absurdities, and obscurities, that we must at last become asham'd of our credulity. Nothing is more dangerous to reason than the flights of the imagination, and nothing has been the occasion of more mistakes among philosophers.

But if, on the other hand, according to Hume (1985a: 267), we (*qua* philosophers) were to reject the above predicament and consequently 'adhere to the understanding, that is, to the general and more establish'd properties of the imagination', then we would end up with an altogether different predicament, which for Hume (1985a: 268) is not just as dangerous as the previous one but also, more to the point, one which is 'attended with the most fatal consequences', for both philosophy and science:

> For … the understanding, when it acts alone, and according to its most general principles, entirely subverts itself, and leaves not the lowest degree of evidence in any propositions, either in philosophy or common life … Shall we, then, establish it for a general maxim, that no refin'd or elaborate reasoning is ever receiv'd? Consider well the consequences of such a principle. By this means you cut off entirely all science and philosophy … We have, therefore, no choice left but betwixt a false reason and none at all … Very refin'd reflections have little or no influence upon us; and yet we do not, and cannot establish it for a rule, that they ought not to have any influence; which implies a manifest contradiction.

Given these above responses of philosophers to the ordinary 'illusions' of the imagination, as presented by Hume, it would seem that the overall dangerous dilemma that we (*qua* philosophers) are reduced to is all tied up with whether it is possible for us (*qua* philosophers) to reason with any certainty about anything regarding the cause and effect events of the world. It would seem that, given Hume's discussion here, we (*qua* philosophers) are not able to reason with any certainty about such causal phenomena.

So, in light of all these philosophical points and/or concerns about how our reasoning from causes and effects is not based on any firm foundation or principles, what then is the ensuing situation for Hume? It is one which leaves him in total despair over whether it is actually possible to accept any of our causal beliefs about the world. As Hume (1985a: 268-9) says:

> The *intense* view of these manifold contradictions and imperfections in human reason has so wrought upon me, and heated my brain, that I am ready to reject all belief and reasoning, and can look upon no opinion even as more probable or likely than another … and … [as a result] … I … begin to fancy myself in the most deplorable condition imaginable, environ'd with the deepest darkness, and utterly depriv'd of the use of every member and faculty [of the mind].

So, it can be surmised here that Hume's empiricist account of cause and effect relations leads him inevitably to a fairly thorough form of philosophical scepticism in regard to our causal beliefs about the world. Moreover, it is a sceptical position which he seems on philosophical grounds – given the particular empiricist principle of his philosophy about how all our ideas are based on impressions – unable to extricate himself from.

Although this is the philosophical position which Hume is logically led to, is there any available reason – philosophical or not – for rejecting it? According to Hume (1985a: 269) there is, but it is not a *philosophical* one:

> Most fortunately it happens, that since reason is incapable of dispelling these clouds, nature herself suffices to that purpose, and cures me of this philosophical melancholy and delirium, either by relaxing this bent of mind, or by some avocation, and lively impression of my senses, which obliterate all these chimeras. I dine, I play a game of back-gammon, I converse, and am merry with my friends; and when after three or four hour's amusement, I wou'd return to these speculations, they appear so cold, and strain'd, and ridiculous, that I cannot find in my heart to enter into them any farther.

So Hume's *non-philosophical* reason for rejecting the sceptical conclusion of his empiricist account of cause and effect relations is provided by 'nature herself' (the real world). Though we may have sound and valid philosophical reasons for concluding that we cannot justify any of our causal beliefs about the world, such a conclusion nevertheless seems 'ridiculous' in the light of our general causal experiences in the world. It seems that whenever we put our hand into the fire it will burn, or when we water a tree it will grow. In these, and other examples like them, we observe that something seems to be the cause of a certain type of effect. These sorts of causal events seem to be undeniable features of our natural world. Only a *philosophical* sceptic, Hume (1985a: 270) seems to be suggesting, would deny this; and conversely, only a *non-philosophical* 'fool' would accept it. Therefore, in the light of these non-philosophical considerations about how the real world seemingly obliterates all our sceptical doubts about our causal experiences of the world, it would appear that Hume is clearly a non-sceptic when he is not engaging in philosophy.

It seems, then, that we have reached an interesting stage in our overall discussion about Hume's empiricist account of cause and effect relations. It seems there are two Humes whose views about the nature of cause and effect relations should be taken into account. There is Hume the philosopher and Hume the player of back-gammon (Mumford and Anjum 2011: 236-7). As a philosopher, Hume is undoubtedly sceptical about the possibility of ever knowing anything about the purported secret powers of objects which necessarily connect things together as causes and effects. As a non-philosopher, however, Hume readily accepts that the world of common experiences is full of many causal phenomena. The question I want to consider here is this: given both Hume's sceptical philosophical account of cause and effect relations and his non-sceptical non-philosophical views about the causal phenomena of the world, how are any of our causal beliefs (like how fire warms or water refreshes) justified?

Clearly, from a philosophical standpoint, Hume thinks that none of our causal beliefs about the world can ever be rationally justified. Yet, at the same time, Hume also clearly thinks that our causal beliefs about the world are in some way valid. So, in what sense are they (if they are at all)? They are for Hume valid in only one way: by whether they survive the test of reality. For instance, if we want to know whether fire either warms or burns us, then the only way to find out is to test the veracity of the belief. If, by putting our hand into the fire, it burns rather than just warms it, we will quickly discover that if we thought otherwise – it would not burn but only be warmed instead – then such a belief will be shown to be irrefutably wrong. As Hume (1985a: 270) says:

> In all the incidents of life we ought still to preserve our scepticism. If we believe, that fire warms, or water refreshes, 'tis only because it costs us too much pains to think otherwise.

So, our motivation for believing in things which lack any sound philosophical grounds or principles is in the end for Hume something which is based on pragmatic considerations. In other words, our causal beliefs about the world are founded only on whether it makes practical sense to accept them. The question is only whether our causal beliefs (or any of our beliefs) about the external world are useful. If such beliefs are not useful, they can be discarded; conversely, if they are useful, they ought not to be discarded.

This pragmatic view about our causal beliefs flows from his sceptical philosophical conclusions about cause and effect relations. Hume denies that we can ever base our accounts of cause and effect relations on any knowledge of the secret powers or ultimate principles of objects which, in turn, necessarily connect them together as 'causes' and 'effects', but he is not denying that all our beliefs are without any sort of foundation at all. The foundation that they do have, which is that they are based on how useful and/or practical they prove to be in light of our experiences of the world, is the only type of foundation that they can have. This, then, is the particular state of affairs (in an epistemological sense) we are necessarily left with, given Hume's sceptical philosophical conclusions about cause and effect relations.

Let us now tease out the 'choices' which Hume's empiricist account of cause and effect relations left the 'positivists' with and point out which one they made and why they did so.

3.4 Choices: which Hume is taken up by the positivists?

Our overall examination of Hume's empiricist account of cause and effect relations shows that Hume has left us with two different strands to his thoughts about causation. One strand is the philosophically sceptical position about causation which logically follows from his basic empiricist principle about how there can be no ideas of anything unless it is based on an original impression of something. The other strand is the non-philosophical non-sceptical one about causation which, as we have just seen, is pragmatically motivated. Hume has thus left us with a choice between two different strands which could be picked up on and pursued within the philosophy of science (Mumford and Anjum 2011: 236-7)

The 'positivists' chose to follow and develop the philosophically sceptical side of Hume's thought, whilst disregarding the non-philosophical non-sceptical side of his thought. They all

essentially accepted the fundamental thesis of his empiricist philosophy from which such a sceptical account of causation follows – that all our beliefs about the world are based on experience and observation. I shall now show how they pursued and developed the philosophically sceptical strand of Hume's empiricism.

3.5 Hume's empiricism as the foundation of positivism: the views of Mach, Poincaré, Duhem and the logical positivists

I shall start with Mach as his philosophical views of science are taken to be the starting point of modern positivism (Kolakowski 1972, Brown 1979 and Oldroyd 1986).

3.5.1 Mach's Philosophy of Science

An analysis of Mach's own views about the basis of knowledge and the nature of causality reveals that they have their source in the seminal ideas of Hume's own philosophy. These Humean-type views about knowledge and causation subsequently provide Mach with the basis for saying that science can only ever study the various connections of phenomena as they are the only sorts of things which are observable on the basis of experience. As a result, science aims to give economical accounts of the observable connections of the phenomena of the natural world in the form of laws and equations. Mach's (1914: xii) overall position is that 'science ought to be confined to the compendious representation of the actual', and as a consequence all metaphysical assumptions which cannot be supported by experience should be eliminated from science (above all, the hidden essence of phenomena). For Mach (1914: xii), all metaphysical elements (from Kant's notion of the thing-in-itself to the mechanical/atomic hypothesis of matter) are ultimately 'superfluous' and 'destructive' of the objectives of the 'economy of science'. The only exception is when, for Mach (1895: 49), the mental representations of what we presume to exist 'behind the appearances' of things (such as the atomic make-up of matter) help us in our scientific investigations of the phenomena of nature; but in that sense, they simply have 'the value of a *memoria technica* [a memory device] or formula' – and once their use is over, they should be dispensed with.

3.5.1.1 The Humean origins of Mach's epistemological starting-point: sensations as the common elements of our experiences

Mach (1914: 46) first says that (1) his views about knowledge are akin to Hume's empiricist philosophy and (2) the epistemological starting-point of his account of science is essentially

the same as Hume's epistemological starting-point: experience is the basis of human knowledge.

For Mach, sensations as the common elements of all our possible experiences of the natural world (physical and psychical) are taken as the starting point for constructing a theory of knowledge. Thus, for Mach, the world of phenomena consists of different combinations of elements. Specifically, the world is comprised of various arrangements of colours, sounds, odours, pressures, temperatures (etc.), along with other sorts of arrangements such as the dispositions of minds, feelings, moods, volitions (etc.) which are sometimes associated with the other types of arrangements. For Mach, an example of this is a sunset at the beach, since it is comprised of various sorts of colours, sounds, odours, temperatures (etc.) as well as different forms of mental dispositions of minds (etc.).

Mach (1914: 1-37) also holds that the component parts of different sorts of things are designated by the two substance-concepts of 'bodies' and the 'ego'. To be more precise, the world of elements is for Mach (1914: 1-37) comprised of (1) 'external bodies' (inanimate and animate), (2) 'my body' and (3) the 'ego'. Thus, when we look at the world on the basis of experience and observation, we will see that it is comprised of these three different types of 'elements'. An example of this is someone like Mach (1914: 19, fig. 1) himself (my body) sitting in a room full of furniture and other objects (external bodies) having mental thoughts, feelings, etc. (ego).

These elements (the component parts) of things are for Mach their properties (colours, sounds, odours, etc.). They are also, for Mach (1914: 1-37), the basis of our 'sensations'. As such, sensations are the means by which we perceive the objective world of elements (external bodies, my body and the ego). If we have no sensations of any elements (the component parts) of things, then we cannot have any mental thoughts about them. That is why Mach (1914: 30) rejects, for instance, the Kantian notion of the 'thing-in-itself'. For Mach, the 'thing-in-itself' is a purely empty or senseless concept as it is devoid of any sensory elements, i.e., when you strip anything of all its sensory components (the properties which make it up) you are consequently left with nothing. To say you are left with 'pure substance' is, for Mach (1914: 30), a meaningless concept. Thus, for Mach (1914: 1-37), the 'things' which make up the world of experience and observation are 'thought-symbols', which in turn stand for 'complexes of sensations' (not the other way around).

Now, Mach's starting point is (as he himself says) essentially the same as Hume's. As we have seen, Hume talks in terms of impressions and ideas. Translated into Mach's terminology they become his sensations (impressions) and thought symbols (ideas). For both, there cannot be any thought symbols (Mach) or ideas (Hume) unless they have their sources in either sensations (Mach) or impressions (Hume). Therefore, Mach accepts – like Hume – that the starting-point of knowledge is the world of experience: i.e., the constituents which make up our experiences of the phenomena of the world (both physical and psychical).

3.5.1.2 The Humean aspects of Mach's views about cause and effect relations: the 'law of causality'

Concerning cause and effect relations, Mach (1914: 83-101) accepts Hume's account of them. For Mach, they are just instances of constant conjunctions. Accordingly, Mach holds that the 'law of causality' designates what he calls the 'dependence of phenomena': each phenomenon is dependent upon another for its occurrence. If a billiard-ball is to move (the effect), then it is dependent on another billiard ball striking it (the cause).

Apart from this, Mach also accepts Hume's thesis about the role of 'habit' in our expectations of what will occur in the future. Habit (as Hume would say) leads us to expect that since *A's* have always been accompanied with *B's* in the past then they will be once again in the future, until they are not (for whatever reason).

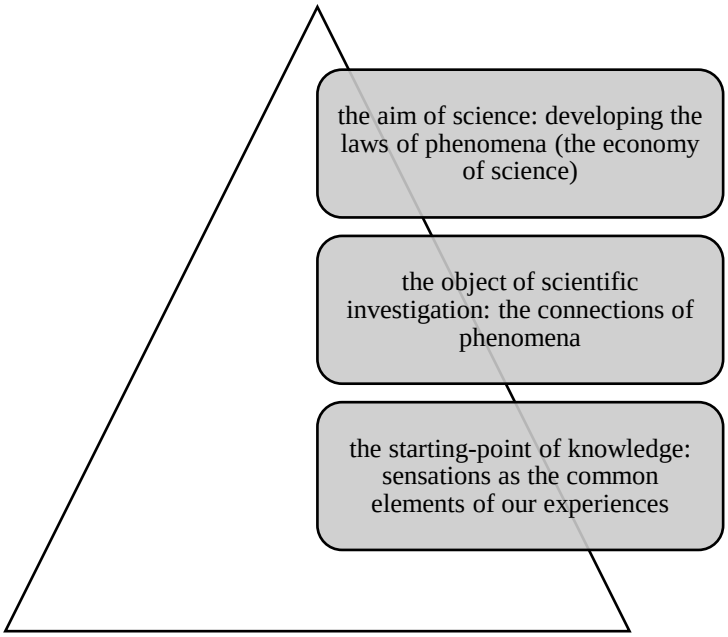
3.5.1.3 Mach's philosophy of science

Given the Humean-type views about the basis of knowledge (experience) and the nature of causation (they are just instances of constant conjunctions), Mach thus develops the following view of science.

First, for Mach (1960: 481-95), the object of scientific investigation is the study and discovery of the connections of phenomena. Thus, for Mach, science studies (investigates) the various connections of phenomena. It also stays within the limits of experience: it does not study (investigate) anything which cannot be observed on the basis of experience. As a result, the aim of science is to discover the exact connections of phenomena: how certain phenomena are always found connected to each other (the dependence of phenomena on one another). Finally, for Mach, science is an extension of experience: it just brings greater order to our experiences of the phenomena of the world.

Second, for Mach, he conceives the central aim of science as the 'economy of science'. By this he means: the 'object of science is to replace, or *save*, experiences, by the reproduction and anticipation of facts in thought' (1960: 577), or by the 'mimetic reproduction of facts in thought' (1895: 193). Science, for Mach, thus aims at 'the *simplest* and *most economical* abstract expression of facts' (1895: 207). As a result, the connections of phenomena are for Mach expressed as laws and/or equations: i.e., as 'abstractions' which leave out all but the essential elements of things (1960: 481-95).

Apart from this, Mach nevertheless says that all scientific knowledge is provisional: it is constantly being revised in light of new facts. Hence, for Mach, we are constantly adapting our thoughts to new facts. In addition, experience and observation is not just the ultimate basis of scientific knowledge, it also marks out the limits of what science can know on it. Let us thus represent graphically Mach's view of science:



3.5.1.4 Mach's ultimate objective: the elimination of all metaphysical elements from science – above all, the hidden essence of phenomena

In developing such a view of science, it is nevertheless the ultimate aim of Mach to eliminate all metaphysical elements from science, especially the so-called hidden essence of phenomena. Mach has four basic reasons for this. First, for Mach, any metaphysical assumption about the

hidden essence of phenomena may (and can only) have a '*memoria technica*' value (the value of a memory device which aids the understanding in thinking about the phenomena under investigation) – beyond this, they are useless. Second, for Mach, any metaphysical assumption about the hidden essence of phenomena is also potentially dangerous as it may lead to literally suggesting that there really are such things as atoms in the natural world which determine the specific make-up of different types of substances. Third, for Mach, any metaphysical assumption about the hidden essence of phenomena is both *superfluous* and *destructive* of the main objective of science, which is to give a simple and abstract expression of the facts of experience. Fourth, for Mach, all metaphysical assumptions about the hidden essence of phenomena are unable to be supported by experience.

3.5.1.5 Conclusion

Mach clearly develops his philosophy of science on the epistemological foundations of Hume's empiricism. Mach's account of science is an attempt at logically developing what follows from accepting Hume's epistemological views about both the *basis* of knowledge (experience and observation) and its *limits* (nothing can be known beyond experience and observation). Overall, Mach's major concern is to rid science of any metaphysical elements (above all, theories about hidden essences) – which is what makes him a positivist. Mach wants science to be based on what is actually knowable rather than what is mere speculation. Therefore, for Mach, science must be based on experience and observation: the only sound basis on which scientific knowledge of the phenomena of the natural world can be acquired.

3.5.2 Some provisional remarks on the explicit and implicit influences of Hume's empiricism on Mach, Poincaré and Duhem

Hume's influence on Mach's philosophy of science (on its development) seems to be pretty direct and explicit. However, is it also so with respect to Poincaré and Duhem? Or is it the case that Hume's influence on their philosophy of science occurs indirectly via Mach's own work? For instance, both Poincaré and Duhem acknowledge Mach's theory of the 'economy of science' and incorporate it into their own accounts about science. They therefore might not explicitly acknowledge the direct influence of Hume's empiricist views about knowledge on their own philosophical account of science because they are simply unacquainted with it. Even so, Hume's indirect influence is still to be felt in their work via Mach's views about the basis and limits of scientific knowledge. Both Poincaré and Duhem explicitly hold that experience and observation is the basis (the starting-point) of scientific knowledge. Furthermore, while

they both accept that the problem of induction (the problem of not being able to justify how the future will be like the past because we are ignorant of what makes it be so) is unsolvable, they nonetheless hold that science works on the principle of induction (i.e., we expect certain things [phenomena] to recur given the prevalence of certain circumstances: if *A* is present, and whenever *A* then *B*, then we expect *B* to also be present once again [to recur]). Consequently, they too (like Mach) set about saying that science can only ever be based on the 'solid foundations' of experience and observation. Accordingly, they each take the aim of science to be about the discovery and description of the connections between phenomena: for Poincaré, it is the 'relations of things', whilst, for Duhem, it is the summarisation and classification of 'experimental laws'. (Both Poincaré and Duhem, incidentally, use metaphors/analogies of libraries and their catalogues [Poincaré] or books and their content pages [Duhem] to explain what they mean by 'theories' and their roles.) Significantly, both Poincaré and Duhem (like Mach) wish to rid science of any metaphysics (speculations about the explanatory causal foundations of phenomena) as it has no place in what is essentially an empirical enterprise. Metaphysical speculations about the causes of phenomena is fine if it helps the scientist with getting a handle on things (a heuristic device, once again), otherwise it can play no real scientific role in establishing the various connections of phenomena. They both thought (like Mach) that such sorts of metaphysical speculations about the hidden essence of phenomena could well prove to be an actual hindrance rather than a useful aid in the end. At any rate, they both thought (like Mach) that such speculations are really redundant in science: science can do what it does (revealing the observable connections of phenomena and formulating them as laws) without any recourse to such sorts of metaphysical speculations (e.g., hypotheses about the atomic-molecular make-up of matter). Let us first sketch out the basic features of Poincaré's 'conventionalist' philosophy of science (Kolakowski 1972, Oldroyd 1986 and Losee 1993).

3.5.3 Poincaré's Philosophy of Science

Poincaré (1905: xix) holds the aim of science 'is not things themselves' but 'the relations between things', such as between things like 'light, electricity, and magnetism' (1905: 194). He (1905: xix) also claims that 'outside those relations there is no reality'. In other words, there are for Poincaré no inner natures of things or essences of phenomena to be discovered, since they simply do not exist. For Poincaré (1905: xix), this is what is established by a consideration of all the sciences from arithmetic and geometry through to mechanics and experimental physics. Such an aim of science is therefore very Humean in character in the sense that like Hume, Poincaré also holds that there are limits to what science can aspire to know – although,

as we have seen, it is not Hume's explicit view that there are no essences of phenomena; rather, he just holds that we cannot ever discover them and hence have any knowledge of them. So, like Mach, Poincaré expresses the central positivistic view of science: the aim of science is not to uncover the essence of phenomena; rather, its sole aim is to reveal the relations between the observable phenomena of the world.

Poincaré (1905: xx) also holds that both the mechanical and physical sciences, unlike arithmetic and geometry, are 'more directly based on experience'. Nevertheless, their 'principles' are just as 'conventional' and non-arbitrary in character as are the 'postulates' of geometry (Poincaré 1905: xviii-xx). Thus, while experience may allow scientists the 'freedom of choice' in terms of which principles of science to choose, it still 'guides' them 'by helping' them 'to discern the most convenient path to follow' (Poincaré 1905: xviii). In short, their choices are based on whatever the world of experience shows them to be the best course to follow.

In addition, Poincaré (1905: xxi) holds that the actual 'method of the physical sciences is based upon induction which leads us to expect the recurrence of a phenomenon when the circumstances which give rise to it are repeated'. However, for Poincaré (1905: xxi), such an inductive principle cannot be rigorously applied: 'If all the circumstances could be simultaneously reproduced, this principle could be fearlessly applied; but this never happens; some of the circumstances will always be missing'. As a consequence, the principle of induction cannot produce any certain outcomes but only probable ones. That is, given how past *A's* produced past *B's* it is probable rather than certain that in the future that *A's* will produce *B's* again. Hence for Poincaré (1905: xxi) there can be no law of certainty in the physical sciences but only a 'law of probability'. Thus Poincaré views the principle of induction along Humean lines.

Concerning the role of metaphysical hypotheses like the atomic-mechanical theory of matter they are not to be taken as literally true since they have no basis in reality. Like Mach and Hume, Poincaré also holds that our ideas of things should be based firmly on our sensations or impressions of them. Nevertheless, they have a role to play in science if they help the scientist to establish the truth of certain types of relations between things, such as 'the relation between gaseous and osmotic pressures' (Poincaré 1905: 181). Thus, for Poincaré (1905: 182), such metaphysical hypotheses should be viewed as only having a 'metaphorical sense' to them. If, however, they are taken as being literally true, then for Poincaré this is a dangerous course for

science to take. For science would be basing its various accounts of the phenomena of the world on unverifiable hypotheses (Poincaré 1905: 182).

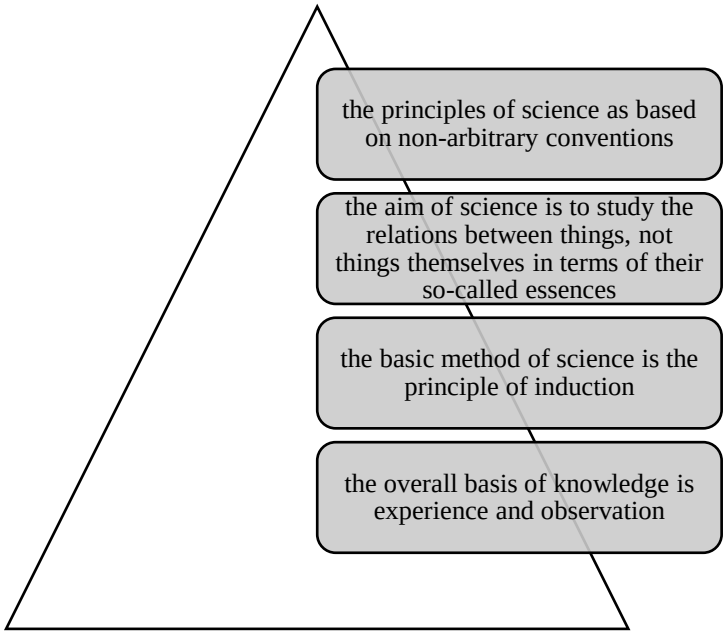
While Poincaré shares in the general positivistic programme of science, what makes his particular philosophy of science conventionalist is that for him you can substitute one hypothesis for another if they both express the same truth about certain types of relations between things. If hypothesis *A* and hypothesis *B* both show that there is a clear and verifiable relation between thing *X* and thing *Y* (such as between light and electricity), then which one you choose depends on such considerations as simplicity, aesthetics or even personal preferences. Thus for Poincaré, there is no single hypothesis of science which is more truthful than another. Scientists choose whichever hypothesis they do out of convenience and whichever serves their interests best of all. In this sense, Poincaré picks up on the conventionalist/positivist aspect of Locke's account of the names of substances.

Apart from this, Poincaré also conceives the overall conventionalist programme of his philosophy of science in terms of a library analogy. In this analogy, he (1905: 161) compares the role of experimental physics (which is concerned with experiments which test various predictions as based on the generalisations of science) with the librarian's ongoing purchasing of new books and the role of mathematical physics (which is concerned with the formulation of hypotheses which are meant to account for the tested predictions of science) with the cataloguing of these new books:

> Experimental physics has to make the purchases, and experimental physics alone can enrich the library. As for mathematical physics, her duty is to draw up the catalogue. If the catalogue is well done, the library is none the richer for it; but the reader will be able to utilise its riches; and also by showing the librarian the gaps in his collection, it will help him to make a judicious use of his funds … That is the role of mathematical physics. It must direct generalisation, so as to increase … the output of science.

What this thus means is that there is no right or wrong way as to how the results of experimental science are classified. What matters is that they can be classified in a systematic and coherent way in accordance with certain scientific hypotheses as provided by mathematical physics. What matters is that there is system and order, not which scientific hypothesis is more correct than another.

We can thus represent graphically Poincaré's view of science:



Given all these aspects of Poincaré's philosophy of science he has more or less built it on the basis of Hume's empiricist views about cause and effect relations and the unknowability of the hidden essence of phenomena. Let us now look at Duhem's 'instrumentalist' view of science (Oldroyd 1986 and Losee 1993).

3.5.4 Duhem's Philosophy of Science

Science, in Duhem's view, aims to study and understand the external world. Duhem proposes that the best and only way of doing this is by basing the physical theories of science (as exemplified in mathematical physics) on the world of experience and observation. Duhem also accepts that the empiricist conception of knowledge as articulated by Hume is basically correct. This is evident in his distinction between what he calls 'physics' and 'metaphysics'. Physics, according to Duhem, is concerned with the study of the external world. As such, it has no other basis from which to start than the facts of experience (this is the *empiricist* stage of science). As a result, it endeavours to discover on the basis of experiments the various laws of phenomena: the 'experimental laws' of science (this constitutes the *experimental* stage of science). Finally, the overall objective is to construct physical theories which, on the basis of their various hypotheses, seek to just summarise and classify the multitude of the experimental laws of nature rather than provide any deep causal explanations for the existence of such laws (this constitutes the *theoretical* stage of science). Metaphysics, on the other hand, is concerned

with stripping away the appearances of things in order to reveal their hidden reality. In so doing, metaphysics aims to reveal the causes and foundations of phenomena – that which ultimately explains and gives rise to the appearances of things (their '*raison d'être*', as Duhem says). Moreover, metaphysics is not based on anything which might be derived from knowledge of the basic empirical facts of the external world. In short, it eschews the empiricist approach to scientific knowledge. The upshot for Duhem is that a clear divide should remain between the domains of *physics* and *metaphysics*. Physics should do what it is designed to do (and can only do) – study the external world on the basis of experience and observation – and it should not be influenced by any metaphysical considerations about the possible underlying reality of appearances (as evinced by the mechanical hypothesis of the time which purported to explain the observable behaviour and patterns of phenomena by the motions of minute particles). If it is, it will only end up failing in its main task: the construction of physical theories which give 'a systematic representation of a group of experimental laws' (Duhem 1969: 23). Metaphysics is, from the viewpoint of physics, an absolute hindrance and is in the province of philosophy, but not science. If one is to speculate about the metaphysical nature of things then one should do so based on the experimental method of science, as such a method will at least guide what one can and cannot legitimately say about the external world. In drawing this type of distinction between physics and metaphysics, Duhem effectively accepts Hume's views about the unknowability of the secret causal powers of objects (the hidden essence of things). Furthermore, Duhem accepts Hume's basic account of cause and effect relations: that they are all just sets of constant conjunctions. So, Duhem's conception of science is positivistic in that it denies the knowability of the hidden essence of things; as a result, he also claims that science can only know, at most, the observable connections of phenomena. Nevertheless, Duhem believes that our physical theories do try to correspond to the 'natural classifications' of the external world (its ontological structure). In this sense, Duhem, unlike both Mach and Poincaré, is some sort of a realist (in a kind of Lockean way). Despite this aspect of his philosophy of science, Duhem should primarily be seen as a positivist. A further reason for construing Duhem's philosophy of science as being positivistic is that it builds on Mach's conception of the 'economy of science'/'economy of thought', which (as we have seen) takes Hume's epistemological arguments about the nature of cause and effect relations as its point of departure. For Duhem, physical theories are simply succinct and economical abstract expressions of the laws of phenomena, which, as articulated by Mach, are equally succinct and economical abstract expressions of the connections of phenomena, which are, in turn, to be observed within the realm of experience.

3.5.4.1 Duhem's conception of science: the construction of a physical theory

For Duhem there are three basic stages to the construction of a physical theory. The first stage, which is the empiricist stage, is concerned with understanding facts as observed on the basis of experience. For Duhem, it is observed on the basis of experience that when two metal rods are rubbed together vigorously or when two sticks are rubbed together vigorously or even two hands are rubbed together vigorously, they all heat up as a result. For Duhem, these are just examples of the observable facts of the external world. On their own, they just form a 'confused mass' of facts (the facts of experience). This is a similar situation to the one Mach describes: the world initially presents itself as a mass of sensory elements which have yet to be organised into clearly defined groups of connected elements (sensations). The task then is to bring systematic order to this mass of experiential facts.

It is notable that Duhem agrees with Mach (and Poincaré) on this matter. Indeed, Duhem (like Poincaré) follow Mach in many ways (e.g., they both accept Mach's conception of the 'economy of science'). This means, in turn, that in accepting a lot of what Mach says, Duhem (like Poincaré) implicitly accepts Mach's epistemological point of departure, which is Hume's empiricism.

For Duhem, the second stage, which is the pure experimental science stage, is concerned with understanding experimental laws. Science, via the method of experiment, aims to establish the laws of phenomena ('experimental laws'). This aim of science coincides with Mach's conception of the 'economy of science', which is to save experience by constructing laws which are, in turn, coherent and succinct abstract expressions of the connections of phenomena. As Duhem notes: this is the first step towards bringing systematic order to our experiences of the world.

To do this, science must invoke and/or employ the method of induction. Duhem accepts the method of induction as the only available method by which to establish the 'experimental laws' of nature. Even though Duhem accepts the inductive method of science, he nonetheless accepts that no philosophical justification can be given for it as Hume has already shown in his account of cause and effect relations. This would suggest that Duhem, without being explicit about it, clearly accepts the epistemological arguments of Hume on this issue.

The third and final stage, which is the pure theoretical science stage, is for Duhem concerned with understanding how all experimental laws fit together in a coherent and succinct way (a project influenced by Mach's conception of the 'economy of thought'). For Duhem, theories

consist of hypotheses. Accordingly, hypotheses express relations between the physical magnitudes of things, which in turn are symbols of their physical concepts. An example of this is temperature: it is a physical magnitude which corresponds to the physical concept of warmth. Importantly, for Duhem, physical concepts are acquired on the basis of our sensory experiences, such as experiencing something as either warm or cold via our physical senses.

It is by the construction of theories that, according to Duhem, physical science can summarise and classify the various experimental laws which have their ultimate source in experience and observation. It is thus at this point of his conception of science that Duhem extends Mach's notion of the 'economy of science/thought'.

For Duhem, physical theories, just like experimental laws, are succinct abstract expressions: in this case, they are concise summaries and classifications of the various experimental laws of nature. The point of this, is to provide science with an easily accessible reference point of how all the various experimental laws of nature fit together in a coherent way. One may say, then, that Duhem completes an account of the specific aims and methods of science which Mach had originally begun as a result of taking Hume's empiricist philosophy as his point of departure.

At this point, it is worth clarifying the relationship between Hume's empiricism and the development of positivism as initiated by Mach. It is this: by his empiricist philosophy Hume provides the epistemological arguments (which are of a sceptical nature) for Mach through to Poincaré, Duhem and the logical positivists (whom we are yet to deal with) for constructing a view of science which (1) denies that the hidden essence of phenomena are knowable and, as a result, asserts that (2) science can only ever know what are the observable connections and/or patterns of phenomena (taking these as the sorts of things which science should focus on as its principal object of study). Thus Hume's empiricist theory of knowledge lays the foundations for the development of a positivistic philosophy of science.

3.5.4.2 Duhem's book analogy

According to Duhem, we can compare theories with the contents page of a book and the experimental laws which are grouped together by or under different hypotheses with chapter titles and their sections and subsections (etc.). Like the contents page of a book, physical theories both summarise and classify the material which is to be found within each chapter and under its various sections, subsections, etc. – ultimately the material in question is none other than the experimental laws themselves. Thus for Duhem, it is the experimental laws which science is really interested in.

Duhem's book analogy is like Poincaré's library analogy. Given this, they both share the 'conventionalist' view about theories. Like Poincaré, Duhem (1969: 37) also holds that theories and their hypotheses are not in themselves either 'true or false'; they are either 'convenient or inconvenient, good or bad' depending on their particular purpose and the rules by which they are constructed.

3.5.4.3 Duhem's 'instrumentalist' conception of the role of physical theories in science

In the end, however, Duhem's view of the physical theories of science is that they perform a basic instrumentalist role in that they ensure a way in which the experimental laws of nature can be systematically grouped together for easy access. Their design is not to help construct any hypothetical explanation about the causes and foundations (the *raison d'être*) of the laws themselves by stripping away the appearances which conceal the underlying reality like a veil.

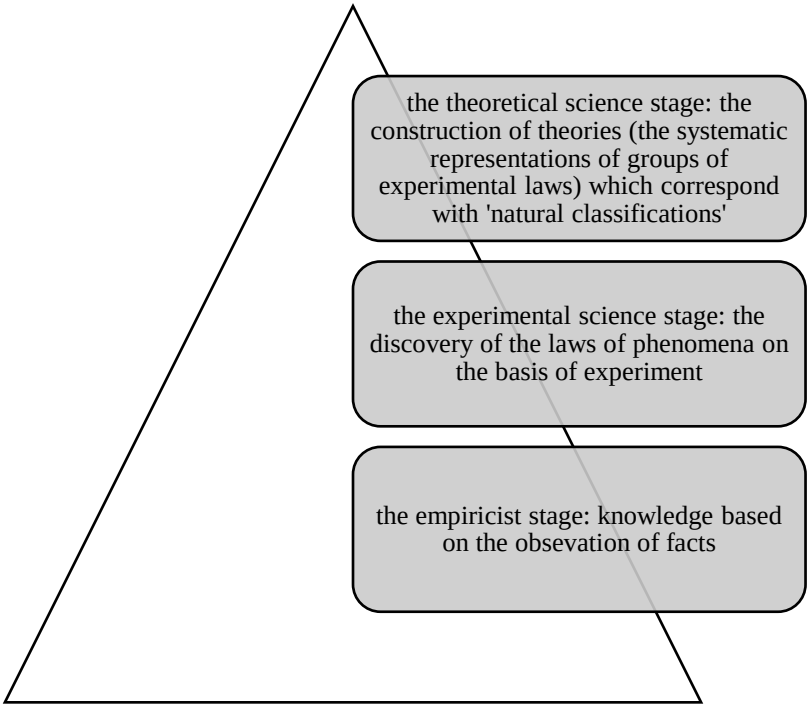
3.5.4.4 Duhem's account of science is not based on any metaphysics

Duhem, like both Mach and Poincaré, does not utilise any metaphysical assumptions about, especially, the hidden essence of phenomena. Duhem's account of science is designed to show that science can only proceed on the basis of experience and observation. Consequently, science is limited to what can be known within the realm of experience and observation. Metaphysical hypotheses like the mechanical hypothesis of the time are, for Duhem, a hindrance to science. They must therefore be ejected from science.

3.5.4.5 The realist aspect of Duhem's philosophy of science

Nevertheless, for Duhem, there is a realist aspect to his philosophy of science. According to Duhem, the physical theories of science may (ideally speaking) correspond with the alleged 'natural classifications' of the external world. Like Locke, then, Duhem seems to think that our scientific categories may match up with real classifications in nature, even though this cannot be done on the basis of knowing what Locke calls the 'real essence' of things or what Duhem (1969) himself calls the reality behind the appearances of phenomena. But in saying this, Duhem is talking only about how the various experimental laws of science may correspond with how in nature things are really connected. Such things as real connections between phenomena in nature are still unknowable on Duhem's (and, of course, Hume's) account.

We can thus represent graphically Duhem's view of science:



3.5.4.6 Conclusion

Duhem, like his predecessors in Mach and Poincaré, sets out to establish a positivistic conception of science which takes as its starting point Hume's empiricist views about both the basis and scope (limits) of knowledge. Accordingly, Duhem also develops a conception of science which holds that it is the sole aim of science to discover the connections of phenomena which are, in the end, just Hume's constant conjunctions. Such a conception of science rejects the hidden essence of phenomena as unknowable. Consequently, it is to be ultimately discarded from science as it has no place nor role to play in it. In fact, it is an actual hindrance to the further development of science on an experiential basis, which for Duhem is the only basis on which science can successfully reflect the phenomena in a coherent and systematic way. Let us now look at the logical positivists.

3.5.5 The Philosophy of Science of Logical Positivism

Logical positivism, as is well known, is a body of thought developed by a major group of early twentieth century philosophers (Moritz Schlick, Hans Hahn, Otto Neurath, Rudolph Carnap, Herbert Feigl, etc.) rather than it being the expression of any one particular philosopher (although Schlick is considered to be its initial lead figure in its development). These philosophers were all concerned with providing a Lockean-come-Humean-type of 'rubbish-clearing' service to the natural sciences (especially physics). They wanted to both clarify the

meaning of the terms/propositions used in science and to eliminate from it all terms/propositions which were found to be meaningless as pseudo-terms/propositions. The philosophical tool for this is the procedure of verification: i.e., the meaning of any term and/or proposition in science was to be established on the basis of whether it could be verified (tested) on the basis of experience; if it could be, it is deemed to have meaning; conversely, it if it could not, it is deemed to be meaningless. This philosophical project was to ultimately jettison from the natural sciences any metaphysical nonsense. For these logical positivists, science could only be of service if it was based on meaningful terms and/or propositions. Now, such an anti-metaphysical project has its immediate roots in Mach's philosophy of science as well as Poincaré's and Duhem's. However, the real foundation of their anti-metaphysical philosophy of science is Hume's empiricist philosophy. Just like Mach, Poincaré and Duhem, the logical positivists also accepted that (1) all knowledge is based on experience, (2) the principle of induction, although a necessary form of inference-drawing in science (and life too), could not be philosophically justified since we lack any knowledge of the hidden causal powers of objects which necessarily link things together as causes and effects, and (3) that all causal relations and/or events are nothing more than instances of regularities in nature (*A's* and *B's* always go together). Given these Humean foundations, logical positivism also took the view that (1) the aim of science *is not* to search for any causal 'depths' in nature (hidden essences) but rather (2) it *is* to simply discover the observable regularities of nature (the regular connections of things and/or events) and to formulate them as laws which, in turn, could be used as the basis for providing explanations and/or making predictions about things. What is important to note here about logical positivism is that it holds the search for the hidden essence of phenomena to be something which is based on metaphysics; and since that is so, that is reason enough for rejecting the view that science should aim to know the causal depths of things. Thus, like Mach, Poincaré and Duhem, the logical positivists also rejected the knowability of hidden essences on anti-metaphysical grounds, which have their source ultimately in Hume's epistemological arguments about the unknowability of secret powers (the 'essence and construction of bodies'). As a result, logical positivism endeavours to be (as Schlick says) a more consistent form of empiricism which draws on the rigours of a logical analysis of the meaning of terms and/or propositions.

3.5.5.1 The basic features of logical positivism

As pointed out by Blumberg and Feigl (1931: 282), logical positivism is 'the union of empiricism with a sound theory of logic'. Accordingly, for them (1931: 282), it is a philosophy

of science which seeks to unite the basic empiricist principle of 'Hume … and Mach', which is 'that all knowledge is based upon experience', with the logical analysis of language of 'Frege and Russell', which is concerned with analytical or conceptual clarity. Its philosophical approach, according to them (1931: 282), is to neglect neither the empirical nor the logical factors in developing what they called a 'unified theory of knowledge' with respect to analysing science. For them (1931: 282), the central problem of the 'empirical tradition of Hume … and Mach' was that, as a reaction 'against the poverty of traditional formal logic', they 'fell into the error of carrying their empiricism too far' by treating, as allegedly done by Mill, 'mathematics and logic as inductively established empirical sciences'. Thus, for Blumberg and Feigl, logical positivism seeks to be a corrective of this philosophical approach while still firmly basing itself on the empiricist principle of Hume and Mach.

3.5.5.2 The upshots of logical positivism

As pointed out by Carnap, Hahn and Neurath (1973: 309), in basing logical positivism on the empiricist principle of Hume and Mach, its proponents subsequently accepted that (1) all 'knowledge' is derived 'from experience, which rests on what is immediately given', and (2) 'this sets the limits for the content of legitimate science'. Thus, for logical positivists, there could be no knowledge of anything in the sciences which had not originated in experience.

Now, the implication of this for science is that it cannot strive to know anything beyond the realm of immediate experience. Thus, for the logical positivists: '… dark distances and unfathomable depths [are to be] rejected. In science there are no "depths"; there is surface everywhere …' (Carnap et al. 1973: 306). In other words, it cannot know anything about the so-called underlying causal foundations of the observable phenomena of the world.

3.5.5.3 The philosophical approach of logical positivism: the verifiability principle

As already suggested in the above, logical positivists see themselves as providing a Lockean-come-Humean-type of 'rubbish-clearing' service to the natural sciences (especially physics). As Carnap, Hahn and Neurath (1973: 314) say: 'on the ground of simple human experience' their overriding task is to remove 'the metaphysical … debris' of science by logically clarifying its various 'concepts, statements and methods'. To do so, however, it draws upon what it calls its 'verifiability principle'. This principle holds that the only way by which the meaning of any term and/or proposition in science can be established is by verifying (i.e., testing) it on the basis of experience. This principle thus picks up on the basic empiricist principle of both Hume's and Mach's philosophy: in Hume's case, if there are no impressions of anything then there can

be no ideas of it, while for Mach if there are no sensations of anything then there can be no thought-symbols of it.

Now, as Blumberg and Feigl (1931: 288) point out, to determine the meaning of any proposition requires that we ask: 'under what conditions a given proposition is true'. In doing so, for them (1931: 288), if 'we can not give these conditions, we do not know the meaning of the proposition'. Thus, for them (1931: 288), if 'the conditions can not possibly be given, the proposition has no meaning'. If, however, it can be verified, then it has meaning. For Blumberg and Feigl (1931: 293) 'the meaning of propositions is identical with the conditions of their verification'. This is very Humean and Machian.

It is notable that Godfrey-Smith (2003: 27) thinks it would had been better if the verifiability theory of meaning had been called the 'testability theory of meaning' as it better captures what they were doing, which is the testing of the truth or falsity of propositions on the basis of observation. I think that this is basically right.

At any rate, this is the analytical method by which logical positivists sought to differentiate between the empirically sound propositions of science and its meaningless ones, which were then taken to be part of the metaphysical debris which needed to be jettisoned from the sciences. The kinds of thing they had in mind can best be illustrated by the distinction between 'observational' language and 'theoretical' language (Godfrey-Smith 2003: 28). Two examples will suffice. First, a distinction between terms: 'red' is an observational term whereas 'electron' is a theoretical term (Godfrey-Smith 2003: 28). Second, a distinction between sentences: 'the rod is glowing red' is an observational sentence whereas 'helium atoms each contain two electrons' is a theoretical sentence (Godfrey-Smith 2003: 28). Now, for logical positivists, in both examples the first part – the observational part – would be deemed to have meaning according to their verifiability principle, whereas their seconds parts – the theoretical parts – would be deemed to be meaningless according to their verifiability principle. If this is accepted, then the first parts of each example would be deemed to be empirically sound propositions of science whereas the other parts would be deemed to be meaningless propositions of science. Given this, logical positivists thus claim we are logically committed to jettisoning the theoretical parts of science as being metaphysical rubbish or debris.

It was therefore by this method of empirical verification (or testing) that the logical positivists sought to jettison the so-called metaphysical debris of the sciences. It was by this method that they sought to rid the sciences of any so-called metaphysical hypotheses like the atomic-

molecular hypothesis of matter (the so-called essences of phenomena). For them, if the meaning of the component parts of this hypothesis could not be empirically verified (or tested), then they were deemed to be meaningless theoretical concepts. As Godfrey-Smith (2003: 35) points out, for logical positivists: 'Scientific language is only meaningful insofar as it picks out patterns in the flow of experience'. Furthermore, as Godfrey-Smith (2003: 35) points out, 'when' – for logical positivists – 'a scientist seems to be trying to describe unobservable structures in the world that give rise to what we see, the scientist must instead be seen as describing the *observable* world in a special, abstract way'. Thus, as Godfrey-Smith (2003: 36) also says, if for logical positivists talking about 'genes' or 'electrons' help scientists to better track 'the patterns of our experiences' then that was a 'good' thing. Hence, for them, the use of such theoretical terms in science was justified on heuristic grounds.

Apart from this, logical positivists also sought to clarify the nature and role of inductive procedures in science.

3.5.5.4 The nature and role of the inductive procedures of science

Logical positivists accepted Hume's thesis about the basis of induction and his conception of cause and effect relations; in particular, how it lacked any certainty as it was not based on any knowledge of the secret causal powers of objects (the essence and construction of bodies) which would ensure that things are necessarily connected together as cause and effect. Thus, for them, cause and effect relations are also nothing but instances of constant conjunctions (regularities). Blumberg and Feigl (1931) typify this view. First, as they (1931: 291) say: 'all scientific theories are built on general propositions whose validity obviously can never be rigorously established'. Second, as they (1931: 291) also say: 'Induction, as Hume says, is not a logical procedure'.

Now, for Blumberg and Feigl (1931: 291), the method by which induction can be legitimised 'without committing the error of attributing certainty to it' is via 'the concept of implication with probability'. So, in this sense they follow both Hume and Poincaré. Thus, for them, all we can expect from induction is that if all *A's* produced *B's* in the past then it is likely or probable that in the future all *A's* will produce *B's* again.

Coupled with this view of induction, they (1931: 291) also hold that the principle of causality (which they have ultimately derived from Hume via Mach and Poincaré) is neither (1) 'a categorical necessity of thought' nor (2) 'a necessary assumption of science'. Nevertheless, for them (1931: 291), it is still a 'model for building laws of nature'. In saying this, Blumberg and

Feigl (1931: 291) thus hold it is up to science itself to determine whether the 'causal (deterministic) laws accurately describes what takes place…', but it cannot ever be 'decided with certainty'.

These views about the method of induction and causality are subsequently summed up in the 'covering-law' model of explanation and prediction of logical empiricism – a milder version of logical positivism (Godfrey-Smith 2003: 35).

3.5.5.5 The logical empiricist conception of the covering-law model of explanation

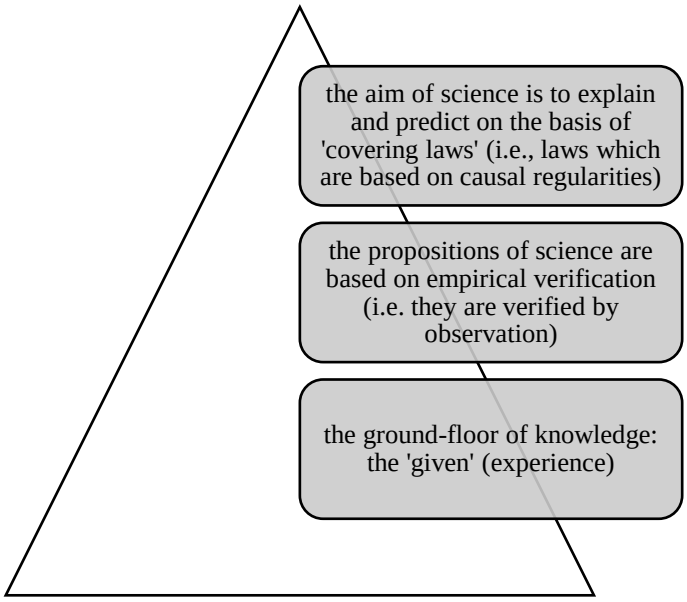
Hempel and Oppenheim (1948) provide us with the classic presentation of the 'covering-law' model of explanation and/or prediction. The schema of the model is:

Law of nature (covering-law) Statement of initial conditions	Explanans (the explainers)
Explanation and/or prediction of events	Explanandum (the explained)

The 'law of nature' – which is a phenomenological law (i.e., a law which captures or expresses only the observable regular connections of phenomena) – is designed to allow us to derive either an explanation or make a prediction of some phenomenological event. Such 'covering-laws' are not designed to express anything about the hidden essence of phenomena – the unknowable 'theoretical entities' of the natural world. As a result, they do not explain and/or predict anything about the phenomena of the natural world on the basis of any hypothesis about such 'theoretical entities'. The 'covering-law' model, as conceived by these two logical empiricists, is constructed on the Humean assumption that all knowledge is not only based on experience and observation but also limited to the realm of experience and observation. In short, the 'covering-law' model does not go beyond the phenomena of the world.

3.5.5.6 Summing-up logical positivism

Let us now graphically represent the logical positivist picture of science:



This graphic reflects what Blumberg and Feigl (1983: 296) took to be the mission statement of logical positivism: 'The purpose of philosophy is the clarification of the meaning of propositions and the elimination of … such meaningless pseudo-propositions' as Kant's thing-in-itself or the atomic-molecular hypothesis of matter.

3.6 Positivism: its main features as a philosophy of science

The main features of positivism as a philosophy of science are:

1. All scientific knowledge about the phenomena of the natural world is both based on and limited to experience and observation.
2. Science is unable to discover and consequently know anything about the hidden essence of phenomena (the causal foundation): it is discarded as unknowable.
3. The aim of science is, above all, just to discover and describe the observable patterns and/or connections between phenomena: they are to be expressed as 'laws of nature' (phenomenological laws).
4. When science offers explanations and/or makes predictions about the phenomena of the natural world it does so in terms of the 'covering-law' model: the phenomenological laws of nature are the 'covering-laws' by which science establishes its explanations and/or makes its predictions about the phenomena of the natural world.

3.7 Conclusion

In this chapter, I have attempted to show that modern positivism, as represented by its main proponents in Mach, Poincaré, Duhem and the logical positivists, has its foundations in, above all, the sceptical strand of Hume's empiricist philosophy. Essentially, these positivists all accepted the basic principle of Hume's empiricism: that all our knowledge of the world (when it is all boiled down) is based ultimately on experience and observation. As a consequence, they all accepted the conclusion about the unknowability of the hidden essence of phenomena which logically follows from this epistemological starting-point of Hume's empiricism. They all accepted Hume's account of causation: that we cannot have any ideas of necessary connections between 'causes' and 'effects' as we are unable to know anything about how the secret powers of objects connect one object to another causally. They thus all accepted that all cause and effect events are nothing more than instances of constant conjunctions. Of course, it does not follow for them that such 'causal regularities' are invalid or lacking in any empirical support. The point is simply that try as much as we like, we will never be able to establish that such causal regularities are in fact 'causal necessities'. Despite this, science can still attempt to discover, as they assert, the causal regularities of nature and express them in the form of 'laws of nature'. Moreover, they can be used as the basis for providing covering-law explanations and/or predictions of the phenomena of the natural world. Indeed, given their dismissiveness of anything that smacks of metaphysics (such as speculations about the causal foundations of phenomena) this is how things should probably be, anyway. Finally, these positivists, as we have seen, have sought to push Hume's empiricist philosophy as far as they possibly could. Of course, in doing so, they have ignored the Hume who still believed in a causal world, even though he could not – given the epistemological premises from which he started – offer any philosophically defensible reasons for believing in it. Indeed, all Hume could say is that: 'If we believe, that fire warms, or water refreshes, 'tis only because it costs us too much pains to think otherwise.' They thus all ignored that part of Hume who could not take his own sceptical account of causation seriously when faced with the realities of the phenomena of the natural world. These positivists seem not to heed Hume's salutary hints. They thus collectively produced the type of philosophy of science called 'positivism'.

II

Marx's critique of political economy as a precursor of contemporary scientific realism: essences taken as completing phenomena and the possibility of theoretical knowledge

Introduction to part two

In this second part of the thesis we look at Marx's critique of political economy in Volume 1 of *Capital*. Marx's (1983: 270) critique of political economy is concerned with a 'critical expose' of the capitalist mode of production. As such it is Marx's (1990: 92) 'ultimate aim' in Volume 1 of *Capital* 'to reveal the economic law of motion of modern society' – that which drives the capitalist mode of production. To do this, Marx goes beyond an initial analysis of what goes on in the process of simple circulation and exchange to an in-depth analysis of what goes on in the process of capitalist production and the reproduction process of capital accumulation. As a result, Marx (1990: 781) ultimately shows that one of the *levers* by which the capitalist mode of production constantly reproduces itself on an ever-expanding scale is the 'industrial reserve army' of unemployed wage-workers. For Marx, this is one of many essential conditions on which the entire capitalist mode of production rests; it is a feature of the very causal mechanism without which the capitalist mode of production cannot operate, let alone develop on a constant, ever-expanding scale.

Given that this is what Marx does in Volume 1 of *Capital*, it can be inferred that his critique of capitalism is a precursor of contemporary scientific realism because Marx not only aims to uncover the underlying causal structure, which in turn gives rise to the observable phenomena of the world, but also does so.

In this part, I shall show in detail how Marx's critique of capitalism anticipates modern scientific realism.

Now, to do this, we will need to present Marx's critique of political economy in Volume 1 of *Capital* in terms of a distinction he draws between appearance and essence, since this is how he conceives his methodological project in Volume 1 of *Capital* (Lebowitz 2009). This distinction of Marx's, which has its philosophical roots in Hegel's conception of the appearance and essence relation (Smith 1990 and Lebowitz 2009), is between the way things immediately appear on the surface to ordinary observation and how things really are, according to science, in terms of their causal foundations (Hunt 1991). It is consequently in terms of this appearance and essence distinction that Marx, firstly, distinguishes between the sphere of circulation and the sphere of production in Volume 1 of *Capital* as, respectively, the appearance and essence

levels of the capitalist mode of production (Larrain 1983). And, secondly, it is what allows Marx (1994: 86) to formulate his conception of the aim of science – which is 'to uncover the essence which lies hidden behind commonplace appearances'. Since it is Marx's aim in his critique of political economy to uncover the essence of the capitalist mode of production which lies hidden behind its appearances, he will go beyond an account of its sphere of circulation, which is at the level of appearances, to an analysis of its sphere of production, which is at the level of essence.

This methodological project of Marx's is nevertheless questioned from several angles, starting with questions about the philosophical validity of his appearance and essence distinction (Wolff 2013) and his conception of the aim of science (Cohen 2001). But *the* central question which can be raised against Marx's methodological project in Volume 1 of *Capital* is: has Marx uncovered the essence of the capitalist mode of production (Blaug 2012)? This is a very important question to address as it goes to the heart of Marx's methodological project in Volume 1 of *Capital*: if it cannot be shown that Marx has revealed the essence of the capitalist mode of production, then it cannot be claimed that his critique of political economy *is* a precursor of contemporary scientific realism. Furthermore, if this question cannot be answered in the affirmative, then no other questions need be raised about Marx's critique of political economy as a precursor of contemporary scientific realism. For instance, there will be no point considering whether Marx's critique of political economy in Volume 1 of *Capital* is an 'exact science' like the hard sciences of physics and chemistry. So answering this major question about Marx's methodological project is something that must be done to show its significance for scientific realism.

This second part of the thesis, then, will develop as follows. First, in chapter four, I articulate Marx's theoretical aim in Volume 1 of *Capital*, so we may grasp its theoretical rationale. Next, I shall present his account of a scientific paradigm (Newton's scientific account of the Keplerian model of the solar system) and explain why he seeks to emulate it in Volume 1 of *Capital*. Then, I shall show how and why Marx couches his theoretical project in terms of a distinction between appearance and essence – which is to uncover the essence of the capitalist mode of production which lies hidden behind its appearances. Then in chapter five, I show how Marx uncovers the essence of the capitalist mode of production in his critique of political economy in Volume 1 of *Capital* (from Chapter 7 through to Chapter 25). This will then be followed, in chapter six, by a defence of Marx's critique of political economy as a precursor of contemporary scientific realism, focusing especially on the question about whether Marx has

actually uncovered the essence of the capitalist mode of production. Finally, I shall sum up how Marx's critique of political economy *is* a precursor of contemporary scientific realism and what is instructive about it.

4

The theoretical and methodological aims of Marx's critique of political economy: the distinction between appearance and essence

4.0 Introduction

The aim of this chapter is to articulate the theoretical and methodological aims of Marx's critique of political economy, as developed in Volume 1 of *Capital*. As we shall see, Marx's critique of political economy centres on the distinction he draws between appearance and essence, which he derives from Hegel's *Logic*. This Hegelian distinction of Marx's is very Lockean.

4.1 Marx's theoretical aim in Volume 1 of *Capital*

In the "Preface to the First Edition" of Volume 1 of *Capital,* Marx (1990: 91) says that what he has 'to examine in this work is the capitalist mode of production, and the relations of production and the forms of intercourse that correspond to it'. Marx (1990: 90) also says that he intends to use the England of his times as 'the main illustration of the theoretical developments' he makes, as England was (according to him) then the most industrially developed of all those countries based on the capitalist mode of production. Marx's intention is not to present a concrete account of any single country based on the capitalist mode of production but rather to present a general and abstract account of the capitalist mode of production itself, which is illustrated by the England of the times.

Different countries based on the capitalist mode of production will exhibit different degrees of industrial development, but Marx (1990: 91) thinks that the country which 'is more developed industrially only shows, to the less developed, the image of its own future'. Marx's claim is that any country based on the capitalist mode of production will tend to develop industrially from a less industrially developed country (like Germany and France) to a more industrially developed country (like England). But how does this all happen?

To answer this question, according to Marx (1990: 91), it is necessary to analyse 'the natural laws of capitalist production'. For, as Marx (1990: 91) says, it is from these 'natural laws' that the industrial development of any country based on the capitalist mode of production tends to 'spring from'. If we want to understand how all this happens then, as Marx (1990: 92) further says, it must be the 'ultimate aim' of such a work 'to reveal the economic law of motion of modern society' – the central developmental tendency which drives any society based on the capitalist mode of production. As Suchting (1983: 79) puts it: what Marx is trying to do in *Capital*, Volume 1, is search for 'the key to the problem of the development of capitalist society insofar as this development proceeds in accordance with economic factors'.

In sum, then, Marx's *Capital,* Volume 1, is all about attempting to reveal the economic law of motion of the capitalist mode of production. This is its theoretical rationale. But how is one to proceed, and why? To answer these questions, we must first consider Marx's paradigm of science: Newton's scientific account of the solar system.

4.2 Marx's paradigm of science

In Volume 1 of *Capital*, Marx (1990: 443) says at one point that while

> it is not our intention here to consider the way in which the immanent laws of capitalist production manifest themselves in the external movement of the individual capitals, assert themselves as the coercive laws of competition, and therefore enter into the consciousness of the individual capitalist as the motives which drive him forward…

(as this is part of the focus of Volume 3 of *Capital*), it is nevertheless

> clear (that) a scientific analysis of competition is possible only if we can grasp the inner nature of capital, just as the apparent motions of the heavenly bodies are intelligible only to someone who is acquainted with their real motions, which are not perceptible to the senses.

If we want to give a scientific analysis of such economic phenomena as capitalist competition, then, just like Copernicus and Newton have attempted to do in their scientific accounts of the 'heavenly bodies' of the solar system, we need to go beyond immediate experience to acquire some theoretical knowledge of how things really are. So, if this first task is not adequately done or worse, not at all, then the other will be impossible to either complete or even start. This is the methodological point to grasp, according to Marx. Given the importance of this

Copernican-Newtonian analogy to Marx's views about his own methodological aims in Volume 1 of *Capital*, let us explore it in greater detail to see what is exemplary about it.

4.2.1 A common-sense view of the solar system

When we casually look up at the heavens from the position of an apparently non-moving earth it appears that all the heavenly bodies of the solar system (the planets, the sun, the moon and the stars) revolve around it. Consequently, the earth seems to be at the centre of the solar system and the universe and stars. This is, in short, a *common-sense* view of our solar system, which is based on our immediate impressions or observations of it. As such, we take the 'apparent motions' of the heavenly bodies (how their motions appear to us) to be their 'real motions' (how they really are). No discrepancy between these two types of motions is visible to us so they seem one and the same.

But what is the *scientific view* of our solar system? From a scientific perspective there have been at least five major models of our solar system: the Ptolemaic, Copernican, Tychonic, Keplerian and Newtonian models. Each of them has attempted to give a true or accurate theoretical representation of the solar system, but as we shall see it is the Newtonian model of the solar system which comes closest to the truth.

4.2.2 Ptolemy's geocentric model of the solar system

Ptolemy's model of the solar system is a geocentric model, wherein the earth is at the centre of the solar system and the universe in general. Like the basic common-sense picture, it too has the sun, the moon and all the then known planets (Mercury, Venus, Mars, Jupiter and Saturn) revolving around it, with the fixed stars of the universe in the background. However, in this model you have these 'heavenly bodies' orbiting around the earth in an outward order, starting with first the moon (which is the closest to the earth), then Mercury, Venus, the sun, Mars, Jupiter and Saturn (which is the farthest from the earth).

Although these heavenly bodies all appear to revolve around a stationary earth along a certain path and in a certain time, it is not for Ptolemy self-explanatory how they all do this. For instance, the planet Mars appears to move for a couple of months at a time in its orbit around the earth in what is called a 'retrograde motion', i.e., 'a backward motion' (Kuhn and Koupelis 2001: 34). When this happens, it first moves eastward in the night-sky (which is its general orbital direction around the earth) before 'looping' back on itself in a westward direction. After a couple of months, it will then 'turn' forward again in an eastward direction and then continue

with its orbit around the earth until its next retrograde motion occurs, and so on. To explain this retrograde motion of Mars, as well as the motions of all the other heavenly bodies of the solar system, Ptolemy theorises that its retrograde motion is the result of it turning in a 'circle' around a point at the centre of this circle as it orbits around the earth in a 'looping path' (Kuhn and Koupelis 2001: 36). Ptolemy's technical term for this is 'epicycle', i.e., a small circle whose centre moves along the circumference of a larger circle (Kuhn and Koupelis 2001: 35). Thus, it is in terms of this concept of epicycles that Ptolemy attempts to explain not just the retrograde motion of Mars but the motions of all the other planets of the solar system as well. In doing so, Ptolemy gives (at least until Copernicus) a reasonably plausible account of a geocentric model of the solar system, which takes account of the retrograde motions of its planets. Thus, he seeks to give a true or accurate representation of the solar system.

4.2.3 Copernicus's heliocentric model of the solar system

In contrast to the Ptolemaic model of the solar system, Copernicus constructs a heliocentric model. In his model of the solar system, we have the sun at the centre of it with all the then known planets revolving around it as follows: first Mercury, then Venus, the Earth with its orbiting moon, Mars, Jupiter and Saturn. These planets all revolve around the sun in a circular motion. Accordingly, Copernicus takes his heliocentric model of the system to be a truer or more accurate representation of the solar system. Furthermore, it is a model in which the 'real motions' of the heavenly bodies of the solar system contradict their 'apparent motions' as observed from the standpoint of a stationary earth, as in the common-sense view of our solar system. Thus, for Copernicus there is a discrepancy between the way the heavenly bodies appear to move around a stationary earth and how they in fact move around the sun, which is at the centre of the solar system.

Now, what makes Copernicus's heliocentric model of the solar system a truer or more accurate representation of it than Ptolemy's is that it explains the so-called retrograde motions of planets like Mars, without the use of epicycles. Copernicus does this through the device of what he calls 'sighting lines' (Cohen 1985: 37). Taking the example of Mars again, Copernicus can explain its 'apparent retrograde motion' (Cohen 1985: 37) by plotting its movement against the background of fixed stars over a period of a couple of months from the perspective of the earth as it orbits around the sun. What Copernicus reveals is that as the earth orbits around the sun the position of Mars will change in relation to it against the background of fixed stars. What results is that Mars will initially be to the east of the earth at one point, then at others it will be

more to the west of it. Now, what Copernicus does is simply plot the relative movements of Mars to the earth against the background of fixed stars on a piece of paper and draw a series of 'sighting lines' between them. What is consequently revealed is that as the earth gradually orbits around the sun the position of Mars will constantly change in relation to it. It will appear as if Mars is moving in a retrograde way, but in fact all that is happening is that Mars is being viewed over time from different positions of the earth's orbit around the sun. This consequently gives the appearance of a retrograde motion for Mars, when in fact it, just like the earth, is orbiting around the sun in an eastward direction. The only difference between them is that they both orbit around the sun at different time intervals, which as Copernicus points out, is due to their respective distance from the sun (Cohen 1985: 37). Mars, because it is further away from the sun than the earth will consequently take longer to orbit around it. Because of this, it will at one point be to the east of the earth and after some time has elapsed it will be to the west of it. Thus, in explaining the apparent retrograde motion of Mars (and for that matter, it can be assumed, all the other planets of the solar system as well), Copernicus offers a strong argument for a heliocentric model of the solar system, as such a simple explanation of the so-called retrograde motions of the planets can only be given if the sun is in fact at the centre of the solar system, with all the other planets (earth included) orbiting around it.

Now, whilst Copernicus was able to show that the orbital motion of planets like Mars did not in fact move in a retrograde way, he did not have any astronomical evidence of what is called a 'stellar parallax', i.e., a shift in the position of fixed stars against the sun as observed from earth (Westfall 1999: 13-15). This phenomenon of a stellar parallax was known to be of crucial importance at the time as it would demonstrate that the earth does in fact orbit around the sun. If it was the case (as it was argued at the time) that the earth orbited annually around the sun on an enormous path, then a shift in the positions of the fixed stars should occur as observed from opposite ends of the earth's so-called orbit around the sun. However, none were observed by the naked eye at the time. Since there was no astronomical evidence of a stellar parallax, then Copernicus could not claim to have fully established the heliocentric model of the solar system as an accurate representation of it. Thus, Ptolemy's geocentric model of the solar system had not yet been refuted. This therefore left room for other models of the solar system to be constructed, again with the intention of producing a true or accurate representation of the solar system, as we shall now see with Tycho Brahe.

4.2.4 Tycho Brahe's geo-heliocentric model of the solar system

In Tycho Brahe's model of the solar system we have a geo-heliocentric model of it. In this model, we have first the earth at the centre of the solar system with its moon orbiting it, and then we have the sun orbiting the earth and its moon. But as the sun does so, the other planets of the solar system (Mercury, Venus, Mars, Jupiter and Saturn) are all orbiting around it; the sun is consequently at the centre of their orbits. This means then that as the sun orbits around the earth (which is at the centre of the solar system), then along with it all the planets are also orbiting around the earth and its moon at the same time. This is a complex, hybrid model of the solar system which combines a geo-centric model of the solar system (i.e., an earth-centric model) with a helio-centric model of the solar system (i.e., a sun-centric model but only in terms of the other planets, minus the earth and its moon). Consequently, it is neither a Ptolemaic nor a Copernican model of the solar system. Tycho Brahe rejected both as an accurate representation of the solar system.

Importantly, Tycho Brahe arrived at this model of the solar system based on an extensive body of astronomical tables and data. This body of astronomical work allowed him to produce accurate accounts of the positions of all the planets of the solar system and the fixed stars of the universe. So, for Tycho Brahe there is an empirical fit between his geo-heliocentric model of the solar system and the positions of all the planets of the solar system and the fixed stars of the universe. In short, there is no evidential gap between them.

Now, with respect to the Copernican model of the solar system, there was one fundamental evidential reason why it was rejected by Tycho-Brahe. It was rejected by him because there were still no astronomical observations of stellar parallaxes, i.e., a shift in the position of fixed stars against the sun as observed from earth. Had there been an astronomical observation of a stellar parallax, then Tycho Brahe would have basically accepted the Copernican model of the solar system. However, as we shall now see, it was Galileo who provided the first real defence of the Copernican model of the solar system.

4.2.5 Galileo's defence of the Copernican model of the solar system: his two main arguments

Galileo sets out to defend the Copernican model of the solar system against the Ptolemaic model with two sets of telescopic observations: (1) the 'four stars' (i.e., moons) of Jupiter and (2) the phases of Venus.

Regarding his telescopic observations of the 'four stars' of Jupiter, Galileo says of them that although they initially appeared to be just four new stars near Jupiter which seem to move along with Jupiter's own orbital movement, it turned out after a prolong study of them that they were in fact all revolving around the planet Jupiter itself. The significance of this for Galileo was that it suggested to him that if four small stars were rotating around a planet like Jupiter then perhaps they were doing so in the same way that, according to the Copernican model of the solar system, the planets revolved around the sun. Thus, for Galileo, the four rotating stars of the planet Jupiter provided some supporting evidence for the Copernican model of the solar system:

> Here we have a fine argument for … the Copernican system … [N]ow we have not just one planet rotating about another while both run through a great orbit around the sun; our own eyes show us four stars which wander around Jupiter as does the moon around the earth, while all together trace out a grand revolution about the sun in the space of twelve years.
>
> (Cohen 1985: 71)

However, it was not, it must be noted, a clinching argument for the Copernican model of the solar system. Galileo was unable to provide any explanation for why the planet Jupiter as it moved in its orbit around the sun did not lose any of its four rotating stars, just as he was unable to explain why the earth itself did not lose its moon as it too orbited around the sun. Thus, he did not a have scientific response to such an objection against the Copernican model of the solar system (Cohen 1985: 71).

His telescopic observations of the various phases of Venus do provide further evidential support for the Copernican model of the solar system. These revealed that Venus, like the earth and the moon, also shined back the 'reflected light' of the sun, which meant it did not shine by any so-called 'light of its own' (Cohen 1985: 71). This would not be possible unless they were all orbiting around the sun. They also revealed that the different phases of Venus could only regularly happen if it were orbiting around the sun. Furthermore, this would account for the different magnifications of each of its phases, meaning that each phase would be of a different size due to its changing distances from the earth. So, when Venus appears for example as a complete lit-up circle like a full moon, then it will be at its greatest distance from the earth in its orbit around the sun. As a result, it will appear as a very small object in the sky. When it appears for instance as a half circle like a quarter moon, it will be nearer to the earth in its orbit

around the sun. In turn, it will appear as a moderate object in the sky. And when it is just a faint crescent, then it will be at its nearest to the earth in its orbit around the sun. So, it will appear as a very large object in the sky. Thus, for Galileo, such telescopic evidence of the different phases of Venus made it very unlikely that (1) Venus orbited around the earth in its epicyclical or retrograde way and (2) that it did so between a stationary earth and a sun which was also apparently orbiting around the earth in a plain circular motion.

So, these are the two chief scientific arguments which Galileo used to defend the Copernican model of the solar system against the Ptolemaic one. However, neither of them provided any conclusive evidence that the earth itself moved around the sun, which would mean that the Copernican model of the solar system was basically correct.

The lack of observation of stellar parallax at the time was due to the great distance of the stars and the lack of sufficiently strong telescopes to observe the small shift of stars from one side of earth's orbit to the other against a fixed reference point on earth.

4.2.6 Kepler's three laws of planetary motion

In the meantime, Kepler had proposed that planets orbited about the sun in nearly circular elliptical orbits. He proposed three laws of motion of the planets about the sun in these orbits, based on the accurate observations of Tycho Brahe. These were:

1. *The orbit of each planet is in the shape of an ellipse with the sun located at one focus*.

2. *In any equal time intervals, a line from the planet to the sun will sweep out equal areas*.

3. *The squares of times of revolution of any two planets around the sun* (earth included) *are proportional to the cubes of their mean distances from the sun*.

(Cohen 1985: 137-40)

Still, Kepler had no explanation of why the orbits were elliptical and especially of why the planets 'swept out equal areas in equal times'.

4.2.7 Newton's scientific explanation

Newton's laws of motion and his law of gravitational force supplied the required explanation and thereby convinced scientists that all the planets, including earth, orbited about the sun, long before evidence of stellar parallax was finally found in the mid nineteenth century.

Newton's laws of motion were:

1. Every body perseveres in its state of rest, or of uniform motion in a right line, unless it is compelled to change that state by forces impressed thereon.

2. The alteration of motion is proportional to the motive force impressed; and is made in the direction of the right line in which that force is impressed.

3. To every action there is always opposed an equal reaction: or the mutual actions of two bodies upon each other are always equal, and directed to contrary directions.

(Hawking 2002: 743-4)

His law of gravitation was:

> [T]hat between any two bodies whatsoever, of masses *m* and *m'*, wherever they may be in the universe, separated by a distance *D*, there is a force of attraction that is *mutual*, and each body attracts the other with a force of identical magnitude, which is *directly proportional to the product of the two masses* and *inversely proportional to the square of the distance between them*.
>
> (Cohen 1985: 165)

Using this and the second law, Newton was able to explain all of Kepler's Laws.

4.2.8 Conclusion: the significance of Newton's scientific account of the solar system for Marx

Newton's scientific account of the solar system provides Marx with two pointers about the aims and achievements of science. First, in having revealed that the real motions of the planets of our solar system are in fact near elliptical orbits around the sun, Newton has demonstrated that if we want to understand the phenomena of the world then we must try to go behind what is immediately apparent to our senses. The central aim of science must be to reveal the underlying reality of phenomena. And second, Newton's scientific account of the real motions

of the planets of the solar system amply demonstrates that such an aim is achievable (both in principle and in practice). For Marx, a critique of political economy should seek to emulate Newton's scientific account of the Copernican-Keplerian model of the solar system, even if this science could not develop mathematical models of observable reality, like those in Newtonian physics. Marx's acceptance of non-mathematically exact sciences relied upon another model of science, provided by Charles Darwin's *The Origin of Species*.

With this illustration of how science proceeded, Marx also took the original step of presenting an account of the appearance and essence distinction in science that was drawn from Hegel's "Doctrine of Essence" part of his *Logic*, and then conceiving the *aim* of science in terms of it – to uncover the essence of phenomena which lies hidden behind its appearances.

4.3 Marx's methodological aim in Volume 1 of *Capital*

I start with a bare-bones account of Hegel's conception of the appearance and essence relation as expounded by him in the "Doctrine of Essence" part of his *Logic*, since this is what informs Marx's own distinction between appearance and essence. But first, some preliminary comments about Hegel's project in this part of the *Logic*.

4.3.1 Hegel's starting point: his reason for developing a conception of the relation between appearance and essence

In what follows, I present Elder's (1981) interpretation of Hegel, as Hegel's *Logic* is not easily accessible without interpretation and Elder's is the best account that I know of for highlighting the causal explanation issues with which I am concerned.

Hegel's conception of appearance and essence is developed by him after his rejection as incomplete of the position of what he calls the 'Understanding' in the "Doctrine of Being" part of the *Logic* (its first part). The 'Understanding' is concerned with what Elder (1981: xviii) calls 'the concepts and categories of surface description', such as something 'being red' or 'being cold'. It takes these types of surface concepts and categories, according to Hegel, as being representative of things which are neither causally determined by something else (such as coldness being causally determined by a lack of heat) or dependent upon another thing for their existence (such as the colour red being compared with another colour); they are, apparently, self-determined and independent entities which can exist on their own. However, Hegel holds that this way of looking at things is wrongheaded, as can be illustrated by the example of redness (Elder 1981: xviii). For something to be red, it must first be seen within a

context in which it stands in contrast to something else with a different colour, say, green; otherwise, how would you know that it is red (and the other thing is green)? So, Hegel's point is that something which is deemed 'red' can only be identified as such in relation to something else with a different colour, such as its opposite. Moreover, what determines something being red (or green, or any other colour) in the first place is that there is something else which causally gives rise to it (such as light reflection). So, if a thing lacks that which determines 'redness', then it will not be red but some other colour instead, say, green. Thus, for Hegel, this is what the 'Understanding' in the "Doctrine of Being" part of the *Logic* fails to grasp about the concepts and categories of surface description: things do not exist on their own and nor are they self-determined (Elder 1981: xviii-xix). Accordingly, for Hegel, one is logically compelled to move beyond the standpoint of the 'Understanding' to one which conceives things in terms of some type of relation between 'essence' and 'appearance', which is what the "Doctrine of Essence" part of the *Logic* is all about.

To help us grasp the basic philosophical point that Hegel is making here, it is worth considering the contrast between Linnaeus's system of natural classification with Darwin's theory of evolution by means of natural selection. Linnaeus sets out to classify the flora and fauna of the natural world into different genus and species according to their phenomenal traits and characteristics. For a flora example, all tall flowering blue gum trees are classified under the genus of *Eucalyptus* and the species of *globulus*, which can in turn be distinguished from other gum trees, such as lemon-scented gum trees which are classified under the genus of *Corymbia* and the species of *citriodora* because of their specific traits and characteristics. And for a fauna example, all 'big cats' like tigers are classified under the genus of *Panthera* and the species of *tigris* because of their pattern of dark vertical stripes on a reddish-orange fur with a lighter shade underneath, which in turn can be distinguished from other 'big cats' like lions which are classified under the genus of *Panthera* and the species of *leo* because of their distinguishing traits and characteristics. However, what is missing from this Linnaean natural classification scheme of the world is any explanation of *why* the natural world divides into these different genus and species. To explain how the flora and fauna of the natural world divides into these different genus and species then you need Darwin's evolutionary account of it. For what Darwin provides is a causal explanation of how the flora and fauna of the natural world have divided into such 'natural classifications'. He does this by explaining the origins of species by claiming that this occurs by the means of natural selection, which is the central causal mechanism by which this all happens. So, based on this contrast between them, what can be

said from Hegel's perspective is that Linnaeus does not go beyond the standpoint of the 'Understanding', i.e., he does not go beyond a surface description of the natural classifications of the world. However, in Darwin's case, we can say from Hegel's perspective that he does by seeing that these natural classifications of the world are based on some causal foundation. Let us now present Hegel's account of the relation between essence and appearance.

4.3.2 Hegel's account of the relation between essence and appearance

In the "Doctrine of Essence" part of the *Logic*, Hegel presents three different types of conception or interpretation of the following specific concept-scheme of 'manifested-appearance-and-underlying-essence' or, alternatively, 'surface-element-and-depth-element', says Elder (1981: xix-xx and 15-16). Hegel does so in relation to such pairs of concepts as 'Sensory Appearances and Physical Thing' and 'Expressions and [physical] Force', as Elder (1981: 16) points out. His goal is to come up with the best possible conception of such a concept-scheme.

The first interpretation of this concept-scheme is the 'A-type' one (Elder 1981: 16). It states that:

Surface-element : Is essentially the reflection of the depth-element

Depth-element : Has a being of its own but is also the ground of the surface-element

So, concerning the concept-pair of, for example, Sensory Appearances and Physical Thing, an A-type interpretation of it would be as follows. Firstly, the Sensory Appearances would be the surface-element of the concept-pair while the Physical Thing would be its depth-element. Therefore, the Sensory Appearance would be 'essentially the reflection of the depth-element' of the concept pair while the Physical Thing would not only have 'a being of its own' but also would be 'the ground of the surface-element'. What this basically means, then, is that when we look at any physical object in the world its various sensory appearances – like the colour, the hardness and the weight of it – will be nothing more than a reflection of the way a physical thing appears to us or manifests itself in the world. Consequently, the sensory appearances of any physical object cannot exist on their own, independently of the physical thing itself. That is because the physical thing is what gives rise to them. So, if you are to see a red chair, for instance, then there must be a physical thing to begin with which gives rise to the appearance of a red chair. However, this does not apply to the physical thing itself. It can exist on its own

and be whatever it is without ever having to manifest any sensory appearances of itself by which we can perceive it.

Now Hegel rejects this A-type interpretation of the concept-scheme of 'surface-element-and-depth-element' or, alternatively, 'manifested-appearance-and-underlying-essence', since the depth-element of a thing cannot exist on its own independently of its manifested surface-element. This is because without the surface-element how would we know that the depth-element exists and has the capacity to produce its surface-element. If we are to know that there is, for example, an electrical charge in the air then we can only know this if it manifests itself as lightning and thunder, otherwise it cannot possibly exist without producing these types of sensory effects.

The next interpretation of the concept-scheme of 'surface-element-and-depth-element' is the 'B-type' one (Elder 1981: 16). It goes like this:

Surface-element : Has a being of its own but is also the reflection of the depth-element

Depth-element : Is essentially the ground or explainer or organiser of the surface-element

So, using the same example of the concept-pair of Sensory Appearances and Physical Thing, we get the reverse situation. In this B-type interpretation, we have the sensory appearances of a physical thing still as the surface-element of it, but with this difference: it is no longer just 'the reflection of the depth-element' of the physical thing, but instead it is something which has its own 'being'; meaning, it can exist independently of the depth-element of a physical thing and be whatever it is. Whereas the physical thing itself 'is essentially … the organiser of the surface-element', which means it is what basically produces the sensory appearances of something, but it cannot exist independently of those sensory appearances. So, if a physical thing is to exist, then it can only do so by manifesting itself in term of its sensory appearances. Hence, the sensory appearances of a red chair (to re-use this example) is the only way the physical thing can exist; it cannot exist independently of how the red chair appears to us.

Hegel rejects this B-type interpretation of the concept-scheme of 'surface-element-and-depth-element' or, alternatively, 'manifested-appearance-and-underlying-essence', basically because the surface-element of things cannot in fact exist on their own independently of what gives rise to it, viz., its depth-element. There cannot be, for instance, a smelly substance (like Sulphur)

unless there is something which produces it in terms of its the internal physical-chemical composition.

The third and final interpretation of the concept-scheme of 'surface-element-and-depth-element' is the 'AB-type' one (Elder 1981: 17-8). It states that:

> *Surface-element* : Is essentially the reflection of the depth-element
> *Depth-element* : Is essentially the ground or explainer or organiser of the surface-element

So, again using the same example of Sensory Appearances and Physical Thing, what we consequently get is a concept-scheme in which the sensory appearances of a physical thing (as its surface element) is 'essentially the reflection of the depth-element' of it, while the physical thing itself (as the depth-element) is 'essentially the… organiser of the surface-element' of it. Thus, in terms of this AB-type of interpretation of the concept-scheme, neither the sensory appearances of a physical thing nor the physical thing itself exist independently of each other. If a physical thing exists then it must manifest itself in terms of its sensory appearances (such as those found in a red chair), while at the same time if something is to have the sensory appearances that it does (such as those found in a red chair) then it can only do so if there is a physical thing to begin with which gives rise to them.

For Hegel, this AB-type interpretation of the concept-scheme of 'surface-element-and-depth-element' or, alternatively, 'manifested-appearance-and-underlying-essence', is the most plausible one of all. This is because neither the depth-element of a thing nor its surface-element can exist independently of one another if they are to both exist. It does not make sense conceptually as they logically presuppose each other – i.e. their existence. So, for instance, if the sun of our solar system is to exist then it must shine light; and conversely, if there is to be light shining throughout our solar system, then there must be a sun which does so. It is simply not possible to have one without the other, according to Hegel.

4.3.3 The Lockean aspects of Hegel's view of appearance and essence

In sum, then, Hegel's view of appearance and essence (the surface-element and the depth-element of things) is that they relate to each other as two distinct aspects of things which are nevertheless interconnected to each other. This means, then, that essence cannot stand on its own nor can appearance. It also means that neither are just the mere reflection (as in the case of appearance) or illustrator (as in the case of essence) of the other. Both necessarily require

each other for their existence. In other words, something cannot have a particular appearance (a manifested surface-element) unless it possesses a certain essence (a causal depth-element) which gives rise to it. And conversely, something cannot possess a certain essence (a causal depth-element) unless it gives rise to a particular appearance (a manifested surface-element). Thus, as conceived by Hegel, the relation between appearance and essence is a logically necessary one.

A modern illustration of this state-of-affairs is the atomic-molecular theory of matter. In Hegelian terms we would say that the specific atomic-molecular make-up of a certain physical object (the metal gold) is its essence component while its particular physical features (its hardness, heaviness, shininess and colour) are its appearance aspects. The former is what causally determines the latter, while the latter is how the former necessarily manifests itself. If, however, this particular physical object lacked the specific atomic-molecular make-up which makes it a piece of gold then it will cease to exhibit all those physical features which are always (or at least normally) observed in a piece of gold. And conversely, if all those physical features which are normally observed in a piece of gold are missing here in this particular physical object (a piece of metal) then it can be inferred that it, at least, lacks the specific atomic-molecular make-up of gold. Thus, in either case, showing that there is a direct correspondence between how something appears at its surface-level (manifested-appearance) and how something is at its depth-level (underlying-essence). You need both for something to be that particular thing, otherwise it will be something else, such as 'fool's gold'.

This is also a very Lockean view given Locke's own conception of the relation between real essences and their nominal essences. For it is Locke's view that a particular real essence (the inner constitution of a thing) will produce a specific nominal essence (the outer observable properties or qualities of a thing); and conversely, a specific nominal essence (the outer observable properties or qualities of a thing) will be the direct result of a particular real essence (the inner constitution of a thing). So, to use Locke's favourite example of gold, it cannot be the case that something will be gold in terms of its specific nominal essence features unless it has the particular real essence of gold; and conversely, if something is gold because of its particular real essence, then it will consequently have the specific nominal essence features that it does. The two presuppose each other, just as they do in Hegel's case. However, there is a difference. In Hegel's case, it is all a purely conceptual or logical way of thinking about the relation between appearance and essence, whereas in Locke's case his conception of the relation between real essences and nominal essences has its basis in the science of his times,

especially in chemistry. The real world of science is Locke's point of departure for his conception of the relation between the real and nominal essence of things.

4.3.4 Marx's distinction between appearance and essence

Now Marx accepts this conception of Hegel's about appearance and essence, i.e., about (1) how appearance and essence are respectively the manifested surface-element and the causal depth-element of things and (2) that they are two distinct but nevertheless interconnected aspects of things. This is apparent, for instance, from Marx's methodological criticisms of what he called 'vulgar economy' and 'classical political economy'. Regarding vulgar economy, Marx (1986: 956) says that it looks at thing in terms of their appearances only, i.e., the surface element of things. It fails to grasp that the appearances of things are grounded on an underlying essence, i.e., a causal depth-element:

> Vulgar economics actually does nothing more than interpret … the notions of agents trapped in bourgeois relations. So it should not surprise us that precisely in the form of appearance of economic relations … that precisely here vulgar economics feels completely at home … the more its inner connections remain hidden…

Indeed, its way of looking at things is representative of the standpoint of the 'Understanding' which, as we have seen, Hegel criticises in his *Logic*. Concerning classical political economy, as represented by (in Marx's view) two of its 'best' figures in Adam Smith and David Ricardo (1990: 174), he has this to say of them. With respect to Adam Smith, Marx says that in his *Wealth of Nations* he fails to clearly distinguish between the two levels of analysis which designate the appearance and essence aspects of capitalism. As a result, he fails to show how, according to Marx (1975b: 106), the essence aspects of capitalism generate its appearance aspects, and conversely, how the appearance aspects are the forms by which the essence aspects manifest themselves:

> Adam Smith … first correctly interprets the relation between profit, wages, etc. … and then he proceeds the other way round … the meaning of this change of approach is that first he grasps the problem in its *inner relationships*, and then in the *reverse form, as it appears in competition*. These two … [different approaches] of his run counter to one another in his work … without him being aware of the contradiction.

And with regards to David Ricardo, Marx (1975b: 106) says that while in his *Principles of Political Economy* he clearly distinguishes between the appearance and essence aspects in his

analysis of capitalism and makes the essence aspects the basis of an analysis of capitalism, he fails to show how the essence aspects give rise to the appearances and how, as a result, the appearance aspects are the forms by which the essence aspects manifest themselves:

> Ricardo … consciously *abstracts* from the form of competition, from the form of appearance, in order to comprehend the *laws as such*. On the one hand he must be reproached for not going far enough, for not carrying his abstraction to completion … On the other hand one must reproach him for regarding the phenomenal form as *immediate and direct* proof or exposition of the general laws …

Thus, in their respective cases, they each fail to operate with either a conception of appearance and essence (vulgar economy) or an adequate conception of appearance and essence (classical political economy). So, like Hegel, Marx too thinks that the correct position to take about the relation between appearance and essence is to see them as both being distinct from one another but nevertheless essentially connected to each other. And consequently, any account of something must be in terms of this type of concept-scheme of appearance and essence if we are to fully comprehend it.

Now, Marx uses this Hegelian conception of appearance and essence to inform him about how to present and structure his account of the capitalist mode of production via his critique of political economy in Volume 1 of *Capital*. What it allows Marx to do basically is draw a distinction between the appearance aspects of the capitalist mode of production and its essence aspects as follows. In Volume 1 of *Capital* Marx (1990: 279-80) takes what he calls the sphere of simple circulation and exchange to constitute the appearance aspect of the capitalist mode of production, while the sphere of production and accumulation is its essence aspect:

> … the market or sphere of circulation… [is] where everything takes place on the surface and in full view of everyone … [whereas] the hidden abode of production [is where] … we shall see, not only how capital produces, but how capital is produced [and the] secret of profitmaking…

In doing so, Marx views the relation between these two different aspects of the capitalist mode of production as comprising two distinct but nevertheless interconnected aspects of the capitalist mode of production. Consequently, we must, on the one hand, view the appearance aspects of the capitalist mode of production – the sphere of simple circulation and exchange – as being causally dependent on its essence aspect – the sphere of production and accumulation; and, on the other, we must view its essence aspect – the sphere of production and accumulation

– as the causal foundations which give rise to its appearance aspects – the sphere of simple circulation and exchange. Thus, as Larrain (1983: 126) says, this is how Marx appropriates Hegel's conception of appearance and essence for his own purposes in his critique of political economy in Volume 1 of *Capital*.

4.3.5 Marx's conception of the aim of science

For Marx, then, it is in terms of this distinction between appearance and essence that he conceives the central aim of not just science overall (which is consistent with the scientific aims of a Newton) but also of the critique of political economy itself. Thus, for Marx (1994: 86), the central aim of science is 'to uncover the essence which lies hidden behind commonplace appearances'. This consequently means in the specific case of the critique of political economy in Volume 1 of *Capital* that the aim is to uncover the essence of the capitalist mode of production in terms of what goes on in the sphere of production and accumulation which lies hidden behind the appearances of its sphere of simple circulation and exchange. What this consequently involves for Marx is that a critique of political economy aims to reveal the causal foundations of phenomena which will not only be the inverse of the way things ordinarily appear on the surface of society, but also be what is required if one is to understand the appearances of the phenomena themselves (how they are produced and reproduced). This is effectively what Marx (1981: 311) says at one point in Volume 3 of *Capital*:

> … *In competition … everything appears upside down.* The finished configuration of the economic relations, as these are visible on the surface, in their actual existence, and therefore also in the notions with which the bearers and agents of these relations seek to gain an understanding of them, is very different from the configuration of their inner core, which is essential but concealed, and the concept corresponding to it. It is in fact the very reverse and antithesis of this.

4.4 Conclusion

Marx's conception of the scientific aim of Volume 1 of *Capital*, as based on the distinction between appearance and essence, therefore constitutes the methodological project of his critique of political economy. It is, as we shall see in the next chapter, married to his theoretical project – which is to reveal the economic law of motion of modern capitalist society.

5

Marx's critique of political economy in Volume 1 of *Capital*: his methodological project and the economic law of motion of modern capitalist society

5.0 Introduction

In this chapter I shall show how Marx reveals the underlying essence of the capitalist mode of production by going from an initial analysis of what takes place in the sphere of circulation between two types of commodity-owners to what actually happens in the sphere of production between two classes of person (capitalists and wage-workers). Crucial to this theoretical analysis of Marx's is his 'Galilean' use of the method of 'successive approximation' – the step-by-step process of going from a fairly abstract and idealised model of things to a less abstract and idealised model of things. In addition, I shall deal with certain objections to both Marx's methodological approach and theoretical claims in Volume 1 of *Capital*. I shall also draw out the Lockean aspects of Marx's critique of political economy as a scientific realist piece of work.

5.1 Starting with the surface-appearances of those societies which are based on the capitalist mode of production

Marx (1990: 125) begins Volume 1 of *Capital* with a description about how things appear on the surface 'of those societies in which the capitalist mode of production prevails'. He (1990: 125) says that the 'wealth' of such capitalistic societies 'appears as an "immense collection of commodities"'. In other words, this is how things both generally and immediately appear to us based on our ordinary observations of such capitalistic societies. Thus, Marx begins with the appearances of the capitalist mode of production.

Marx is consequently doing something comparable to what was done in the scientific accounts of the solar system. The scientific accounts of the solar system from the Ptolemaic one to the Newtonian one all started with (as we saw in the previous chapter) the appearances of the solar system – the apparent motions of the heavenly bodies, since these were the phenomena which

needed explaining. So, similarly, Marx starts with the appearances of those societies in which the capitalist mode of production prevails, since the way the wealth of such societies appears in terms of an immense collection of commodities needs explaining. Such phenomena cannot just be taken for granted; they are presumably the product of something which is not apparent on our initial perceptions of such capitalistic societies.

In addition, like the apparent motions of the heavenly bodies, which were (or are) taken to be real phenomena in the sense that it really is the case that they (the sun and planets) seem to revolve from east to west over an apparently stationary earth, so the phenomena of capitalistic societies in which its wealth appears as an immense collection of commodities is also real. In short, just like the phenomena of the solar system, there is no need to dispute the veracity of the way things appear on the surface of capitalistic societies: they are not illusions or tricks of the eye.

This is an important point to grasp about Marx's notion of appearance. Some, like Popper (1974 and 1990) for instance, ascribe to Marx the view that 'appearances' stand for something that is not real. Popper does this as he takes Marx to be employing a distinction between reality and appearance rather than essence and appearance. This is because he interprets Marx's so-called views about 'reality' and 'appearance' based on Plato's Theory of Ideas (or Forms), wherein it is Plato's view that the Ideas (or Forms) stand for reality while the appearance of things (as symbolised by the flickering shadows on the walls of the cave) stand for faint impressions of reality, in short, illusions. For Marx, as we have just seen, appearances (i.e., the way things appear on the surface) are in fact real and that is how they should be viewed. Popper is not, as we shall later see, the only one to mis-attribute to Marx a notion of appearance which he does not hold (for example, Blaug 2012).

In commencing with a description of the way the wealth of capitalistic societies appears on the surface of things, Marx firstly abstracts from the complexities of what makes up those societies which are based on the capitalist mode of production, as pointed out by Hunt (2015: 67). Thus, he abstracts from the class composition of such capitalistic societies, as well as from the institution of the market and the way commodities are produced for it under capitalistic social conditions or arrangements, plus from capitalistic competition itself. As a result, Marx (1990: 125) begins with an analysis of the commodity since 'the individual commodity appears as [the] elementary form' of wealth in capitalistic societies.

There is some debate about what Marx is doing here at the start of his theoretical analysis of the capitalist mode of production. Is he simply embarking upon a method of presentation which follows a 'linear logic' path or is he following a path in terms of a 'systematic dialectic' logic (Arthur 2004: 17-18)? According to Arthur (2004: 18), a 'linear logic' path position construes Marx as beginning with a 'one-class' model of a 'simple commodity production' society in his initial analysis of the individual commodity, which is then developed further into a 'two-class' model of the capitalist mode of production. While the 'systematic dialectic' logic path position, Arthur (2004: 24-33 and 63-78) says, interprets Marx as instead developing his account of the capitalist mode of production in terms of a 'dialectically' systematic presentation of the 'economic categories' themselves, beginning first with the economic category of the 'commodity', then followed by 'exchange', 'money' and 'capital' itself, and so on.

Now, it is certainly true, as Arthur (2004: 17) himself claims, that Marx presents a systematic analysis of the economic categories which comprise the capitalist mode of production. As Marx (1983: 270) says, his critique of political economy engages in not just a 'critical expose' of the capitalist mode of production itself but also, at the same time, 'a critique of [its] economic categories'. So, Arthur is not incorrect in emphasising this aspect of Marx's critique of political economy. To be fair, Arthur (2004: 17) says it is because 'Marx's object of study is a *totality*', meaning, that Marx is wanting to grasp the capitalist mode of production overall rather than just parts of it, that one should read Marx as developing his account of the capitalist mode of production in a 'dialectical' way.

However, this 'systematic dialectic' position of Arthur is predominantly focused on the logical development of the economic categories found in Marx's *Capital* in accordance with the principles of Marx's 'dialectical logic'. Now, I am not wishing to dispute this. But, given that our focus here with respect to Marx's critique of political economy being a 'work of science' which seeks to emulate the scientific achievements of Newton, then it seems incumbent on us to focus on those aspects of it which make it a 'work of science'. Therefore, we should focus on Marx's critique of political economy from the perspective of it being a work in which he develops his account of the capitalist mode of production along a 'linear path' which, even Arthur (2004: 21) acknowledges, employs the method of 'successive approximation', i.e., the method 'which proved so successful in Newtonian science'. This means, in short, focusing on how Marx develops his account of the capitalist mode of production *via* the use of highly abstract and idealised models, as found in Galileo (Nowak 1980 and Suchting 1983).

There is also an additional reason why we should do this, which Arthur fails to consider in his discussion of 'dialectical development' versus 'linear logic'. It is this: when we (later) consider Marx's discussion about how the capitalist mode of production constantly reproduces itself on an ever-expanding scale in Part 7 of *Capital*, what will be disclosed is that Marx does so by constructing a series of models, with each successively building upon the previous one. Thus, in his attempt to reveal the economic law of motion of modern capitalist society Marx does so *via* the method of 'successive approximations'. Thus, the use of highly abstract and idealised models plays a pivotal role in the methodological development of Marx's scientific account of the capitalist mode of production. This position is close to Smith's (1990), although it is still his intention to present a 'dialectically systematic' presentation of Marx's critique of political economy in Volume 1 of *Capital*.

It is worth clarifying what is meant by the notion of *highly abstract and idealised models* in Marx's critique of political economy. Briefly, following Godfrey-Smith's (2009: 47) account of the terms 'abstraction' and 'idealisation', we can say that, firstly, by 'abstraction' we mean the mental act of 'leaving things out, while still giving a literally true description' of the thing in question; and secondly, by 'idealisation' we mean the mental act of 'treating things as having features they clearly do not have'. Thus, for example, when Marx (as we shall see) initially discusses the capitalist process of accumulation in terms of his model of 'simple reproduction', he does so by (1) leaving out all those features of the capitalist mode of production which are not at that stage of his analysis relevant (such as how the 'surplus-value' gets divided up amongst the three main property-owning classes – amongst the sub-classes of capitalist, which are the industrial capitalists, financial capitalists and capitalist landlords); and then by (2) treating the capitalist mode of production as if it is simply a system of simple reproduction when in fact it is not. Consequently, he presents us with a highly abstract and idealised model of the capitalist mode of production in terms of a simple reproduction process. This is as Nowak (1980) and Suchting (1983) point out the 'Galilean' method which Marx employs throughout *Capital*.

So, Marx commences with an analysis of the 'individual commodity'.

In his analysis of the individual commodity Marx does several things. First, he defines the 'commodity' as something which has both a use-value and an exchange-value, i.e., it is both a thing of use and a thing which can be exchanged with other useful things (i.e., commodities) in certain proportions. Second, he claims that commodities exchange with one another based

on their 'values', i.e., certain amounts of what he calls 'socially necessary labour-time' (which is, of course, the 'quantitative dimension' of his labour theory of value). Third, he then shows how commodities exchange with one another for money (which Marx takes to be the 'form of appearance' of value). Fourth, he then claims that behind the various exchange relations of commodities – *x* amount of commodity *A* exchanged for *y* amount of commodity *B* for *z* amount of money – there is a 'social relation' between individual commodity producers. However, this social relation between individual commodity producers is not apparent in the various exchange relations of commodities. Hence, for Marx, the exchange relations of commodities hide from the immediate producers of commodities the specific social institutional arrangement or framework in which this occurs: they occur because of a social relation between the direct producers of commodities; if this social relation is not in place, then there can be no exchanges between commodities in the marketplace. Marx (1990: 165) calls this phenomenon the 'fetishism … of commodities' as it designates a situation in which 'the products of the human brain appear as autonomous figures endowed with a life of their own …'. In other words, in the minds of individual commodity producers it appears as if commodities exchange with one another, independently of the social relations in which they are produced for the marketplace.

In analysing the individual commodity Marx has done so in terms of an abstract model of 'simple commodity production' (although, as Arthur (2004: 19) rightly points out, Marx never uses this 'term' himself, except 'once' in Volume 3 of *Capital*). What this all amounts to is a model in which there are only simple commodity producers (such as artisans) who, as 'private individuals' (Marx 1990: 165), own their own means of production and work for themselves, making useful things to be exchanged for money in the marketplace. In analysing the individual commodity in terms of this model of a simple mode of commodity production, Marx thus draws out some general features of such a mode of commodity production. It consequently allows Marx to reveal, above all, that any society which is based on the commodity mode of production will exhibit the intrinsic feature of commodity fetishism. As such, the exchange relations of commodities will always hide the true nature of how they come to be exchanged in the marketplace. The implication of this for the capitalist mode of production is that, since it too is a form of commodity production, then it will necessarily exhibit the same phenomenon of commodity fetishism. Hence, the economic participants of such a society will not necessarily understand how commodities come to be exchanged in the marketplace.

It is worth noting that the phenomenon of commodity fetishism is taken as the 'rationale', the 'theoretical imperative' for why Marx must, as claimed by Geras (1973) for instance, reveal

the underlying essence of the capitalist mode of production. It needs to be done, as Geras claims, if people are to understand how the capitalist mode of production not only conceals the 'truth' from them but also how it works. As Geras (1973) claims, it is the epistemological justification for Marx's critique of political economy in Volume 1 of *Capital*. Furthermore, it is what turns it into a 'critical science' which distinguishes it from other sciences, such as Newtonian science (Geras 1973). However, this very phenomenon of capitalism is also, as claimed by Cohen (2001) for instance, the very undoing of Marx's conception about the aim of science. According to Cohen, once the phenomenon of commodity fetishism disappears under a non-market socialist society then there is no longer any need for science, given that Marx takes the point of science to be based on a discrepancy between appearance and essence. So, the phenomenon of commodity fetishism throws up some important issues about the scientific point of Marx's critique of political economy in Volume 1 of *Capital*.

It is not my intention, at this stage, to cover these issues concerning the scientific point of Marx's critique of political economy in Volume 1 of *Capital*. However, these issues surrounding the point of Marx's scientific project in Volume 1 of *Capital* will need to be dealt with in the next chapter, if we are to defend Marx's critique of political economy as a precursor of contemporary scientific realism. But, when I do so, I shall show that Marx's conception of the aim of science is not invalidated by the disappearance of commodity fetishism under a non-market socialist society. Science, in general, still retains its central aim of attempting to uncover the hidden causal structures which give rise to the observable phenomena of the world. If this were not the case, then contemporary scientific realism would be a fruitless philosophical and scientific project.

Now, Marx rounds off his presentation of the first part of his critique of political economy by going on to explain, firstly, how commodities cannot just exchange on their own in the market since they in fact require their owners, the private individuals who produce them for the market, to bring them. And then, at great length, Marx goes on to explain how commodities circulate in the market by the means of money. What Marx essentially shows here is that in the process of simple circulation commodities are exchanged for money which is then exchanged for commodities, and so on. Marx thus represents this process of the simple circulation of commodities via the means of money as:

C (commodity) – M (money) – C (commodity).

As a result, Marx presents us with an abstract model of a simple mode of commodity production which is comprised of the following essential features: (1) it is based on a society of private individuals who produce their privately owned commodities for the market in exchange for money, (2) the owners of commodities are the only ones who bring commodities to the market, and (3) all commodities circulate in the market via the means of money. Thus, at this stage of his presentation in Volume 1 of *Capital* Marx has done nothing more than presented us with an abstract model of simple commodity production *and* circulation, which also exhibits the phenomenon of commodity fetishism.

Given that Marx has done this, it cannot be claimed that Marx has somehow presented us with a 'logical-historical' (Arthur 2004: 17) model of a society based on simple commodity production and circulation which not only reflects a stage of human society that predates those societies which are based on the capitalist mode of production but also consequently gives rise to them, as is allegedly done 'from Engels, through Sweezy, through Meek, to Mandel' (Arthur 2004: 18). There is simply no evidence for this interpretation of what Marx is doing at this initial stage in Volume 1 of *Capital*. In fact, there is contrary evidence in Marx's *Capital*, Volume 1, which shows that he clearly understood the precise historical conditions which allowed for the emergence of those societies based on the capitalist mode of production, as evident by his discussion of the historical emergence of capitalism in his chapter on 'original' or 'primitive' accumulation (Ch. 26 of *Capital*, Volume 1).

Now, a point of clarification about Arthur's position. Arthur does not claim (like Sweezy et al.) that Marx has actually presented us with a 'logical-historical' model of simple commodity production; rather, he rejects this as an interpretation of Marx. Arthur seems to take the 'logical-historical' role as the only one that simple commodity production can play. Consequently, it can still play a role as an idealisation that does not take on anything but a marginal form in the societies from which capitalism is born, i.e., it can be one part of a social formation that is dominated by the feudal mode of production. So I agree with Arthur in claiming that Marx does not do what some seem to say that Marx does (Sweezy et al.) but disagree with Arthur that social formations such as feudalism might contain simple commodity production but in a form modified by its relation to the dominant mode of production.

Marx's next step in his methodological presentation is to move from this abstract model of a society based on simple commodity production *and* circulation to, *firstly*, an abstract model of a two-class society of the capitalist process of exchange and simple circulation in Part 2 of

Volume 1 of *Capital* (which is not immediately apparent but is nevertheless presupposed by Marx). So, as we shall now see, he builds successively on the previous abstract model. But in doing so, Marx also shifts his theoretical focus to a central puzzle which needs to be resolved if we are to understand the nature of the capitalist mode of production. This puzzle is concerned with how money gets converted or transformed into capital (i.e., more money) in the marketplace.

Marx sets this puzzle up as follows. First, he discusses the basic circulation process of money by the means of commodities. Marx says that money is first exchanged for commodities in the marketplace (i.e., money is used to purchase a certain quantity of commodities); and then, commodities are exchanged back for money in the marketplace (i.e., a certain quantity of commodities are sold for money). This type of circulation process can be thus expressed as:

M (money) – C (commodities) – M (money).

This is, as Marx says, the direct opposite of the simple circulation process of commodities by the means of money. An example of this is: $100 is firstly exchanged for 50 kilos of flour (a purchase), and then 50 kilos of flour are exchanged for $100 (a sale). Now, what this example demonstrates is that there is no increment in the amount of money at the end of this simple circulation process of money by the means of commodities. However, for someone whose aim as the owner of money is to make more money via the means of commodities, then this is not the market outcome they want. So, for Marx, what needs to happen is this:

M (money) – C (commodities) – M’ (more money).

For example: $100 is firstly exchanged for 50 kilos of flour (a purchase), and then 50 kilos of flour are exchanged for $110 (a sale). As can be noted here with this example, there *is* an increase in the amount of money at the end of this process. So, this is what needs to happen if the aim of someone (the money-owner) wishes to make more money than they have put into it in the simple circulation process of money by the means of commodities.

The upshot of this analysis of the simple circulation process of money by the means of commodities is that the increased amount of money at the end of the process, as represented by the symbol M’ in the above formula, is for Marx (1990: 251) an expression of what he calls ‘surplus-value’ and it is for him the difference between the initial amount of money spent at the beginning of the process and what is made at the end of it. It is subsequently through the

creation of this 'surplus-value' which allows money to be converted or transformed into capital (more money).

Now, what Marx is depicting here through this analysis of the simple circulation process of money by the means of commodities is how capitalists *appear* on the face of it to convert money into capital (more money) in the marketplace, i.e., within the sphere of simple circulation and exchange. However, there is a problem here: what is the origin of surplus-value itself? For Marx, this is a puzzle whose answer is not on *prima facie* grounds immediately apparent. This is principally because, as Marx tells us, the purchasing of commodities and their selling in the marketplace by capitalists all occurs on the assumption that commodities exchange at equivalent 'values' (i.e., equivalent amounts of labour-time) and so, under this market exchange, commodities are neither bought nor sold above or below their values. Hence, the puzzle that Marx uncovers at this stage of his analysis of what is effectively the beginnings of a model of the simple process of circulation and exchange *of* the capitalist mode of production. It is an incomplete model as something crucial is missing from it, which is a 'special commodity' which, as Marx (1990: 270) says, the capitalist must purchase in the marketplace if they are to convert their money into capital via the creation of surplus-value. For Marx (1990: 270), it is the commodity which wage-workers sell to capitalists in exchange for a wage – their 'labour-power', i.e. their capacity to perform labour.

Before going on to complete Marx's model of the capitalist process of simple circulation and exchange, it needs to be noted that the solution to the problem of how surplus-value is created is to be found, Marx (1990: 268) says, 'both in circulation and not in circulation'. Thus, the first part of this solution is, as just implied, the capitalist's purchase of the commodity of labour-power from wage-workers in the marketplace – *in the sphere of circulation*.

Marx's focus on the capitalist person is that of the industrial capitalist and not the merchant capitalist, as he points out at the end of Chapter 5 of Volume 1 of *Capital*. This is because the merchant capitalist is simply someone who purchases commodities in the marketplace at a lower price to then resell them at a higher price at another time and place, and consequently makes a profit. Whereas the industrial capitalist is in the business of producing commodities for the market in the hope of making a 'profit', but to do so they must first purchase this 'special commodity' of labour-power from wage-workers in the marketplace. This is what marks out the capitalist mode of production, since merchant capitalists have operated in other modes of production as well, although under capitalism they also play the role of taking over the part of

the process of making money by selling the industrial capitalist's products to customers. Marx's theoretical focus is therefore on the core aspects of the capitalist mode of production rather than on its peripheral or incidental aspects, which is what the market activities of the merchant capitalist belongs to.

So, what are the specific social conditions which allow the industrial capitalist to purchase the commodity of labour-power from wage-workers in the marketplace which Marx holds is essential to the process of the capitalist converting or transforming their money into capital? According to Marx (1990: 272), there are two 'essential condition[s]' which must be in place in the marketplace. Firstly:

> … labour power can appear on the market only if … its possessor offers it for sale or sells it as a commodity. In order that its possessor may sell it as a commodity, he must have it at his disposal, he must be the free proprietor of his own labour-capacity, hence of his person … and … he must constantly treat his labour-power as his own property, his own commodity, and he can only do this by placing it at the disposal of the buyer [i.e., the capitalist] … for a definite period of time, temporarily …
>
> (Marx 1990: 271)

And secondly:

> … the possessor of labour-power, instead of being able to sell commodities … must rather be compelled to offer for sale as a commodity that very labour-power which exists only in his living body.
>
> (Marx 1990: 272)

Consequently, for Marx (1990: 272-3), if the capitalist is to convert or transform their money into capital, they as

> the owner of money must find the free worker available on the commodity-market; and this worker must be free in the double sense that as a free individual he can dispose of his labour-power as his own commodity, and that … he has no other commodity for sale …

And all this consequently implies or presupposes that, unlike the capitalist who 'posses[es] the means of production, such as raw materials, instruments of labour, etc.' (Marx 1990: 272), the wage-worker does not: all they own is their labour-power.

So, for Marx, it is a necessary condition of the capitalist mode of production, as being developed within this first stage of it in terms of the model of a simple circulation and exchange process, that the capitalist and wage-worker meet in the marketplace wherein the capitalist purchases with money the commodity of labour-power from the wage-worker. For it is only on this basis that the capitalist can then use this commodity to convert money into capital by the creation of 'surplus-value'. This latter process, as we shall shortly see, is what is done *outside of the sphere of circulation* – in the sphere of production itself.

Now, for Marx (1990: 274), this commodity of labour-power is a 'peculiar commodity' as it is the only commodity which, even though it like all other commodities has a 'value' which is represented by its 'money-price' (i.e., in the form of wages), it nevertheless has the unique capacity to create 'value' independently of the 'value' it contains. Consequently, it is the specific commodity which the capitalist needs in order to create the 'surplus-value' which allows them to convert money into capital in the market. This is therefore its unique feature. It should be noted, here, that Marx also draws a distinction between 'labour-power' and 'labour': the former is, as he says, the capacity to perform labour, whereas the latter is the activity itself (i.e., labouring or doing work).

Apart from this, however, the capitalist consequently acquires the legal right to use this commodity of labour-power in such a way that best suits their economic interests, as summed up by their desire to convert money into capital. As we shall see, this means putting the wage-worker to work in the production process with the specific purpose of producing commodities to be sold in the market in exchange for money, in the hope that this will create 'surplus-value' which is what the capitalist must do if they are to convert money into capital.

This pivotal discussion of Marx's at this stage of Volume 1 of *Capital* is questioned by some, such as Wolff (1980) for instance. Wolff's (1980: 12-13) specific complaint here is that despite the fact that Marx points out that wage-workers are forced as a consequence of being separated from the 'ownership or effective control over the means of production' to 'sell their own laboring capacity as though it were a commodity', he is wrong to overemphasise the importance of the commodity of labour-power itself and the subsequent distinction he draws between labour-power (which is the capacity to perform labour) and labour (which is the activity itself). (It must be noted that Wolff makes this complaint against Marx in the context of his discussion of what the secret of capitalist exploitation is.) In Wolff's view, what needs to be emphasised here is not whether the capitalist finds the 'special' and 'peculiar' commodity of labour-power

on the market, but rather that 'wage labour' itself exists to begin with. For it is his implicit point that if there is no wage labour to begin with, then how can there be any labour-power commodity to be found on the market by capitalists. This seems a fair point to make. However, as Wolff (1980: 12-13) himself also says at the start of his complaint, 'as Marx is often telling us … under capitalism … human productive activity' is constantly being transformed 'into a commodity to be bought and sold on the marketplace'. Since this point of Marx's is clearly acknowledged by Wolff, and moreover, it is what Marx himself presupposes in his above discussion about the selling and buying of the commodity of labour-power in the market, it would appear then that this complaint is not as fair as it might initially sound. What Wolff is failing to recognise here is that the commodity of labour-power is what the capitalist *must* acquire from the wage-worker *if* they are to convert their money into capital. The existence of wage labour *is* a necessary condition *but not* a sufficient condition from the perspective of the capitalist whose aim is to convert money into capital in the sphere of simple circulation and exchange (the marketplace). The former needs to exist of course, but the other needs to be also there. Wolff has got the emphasis back to front.

At any rate, after outlining the phenomena of exchange of commodities in the market, Marx (1990: 279-80) announces that we cannot understand how the capitalist intends to make a profit from his purchases of raw materials and labour power in the marketplace, without considering what happens in the sphere of production:

> Let us, therefore, in company with the owner of money and the owner of labour-power, leave this noisy sphere, where everything takes place on the surface and in full view of everyone, and follow them into the hidden abode of production … [to] … see, not only how capital produces, but also how capital is itself produced …

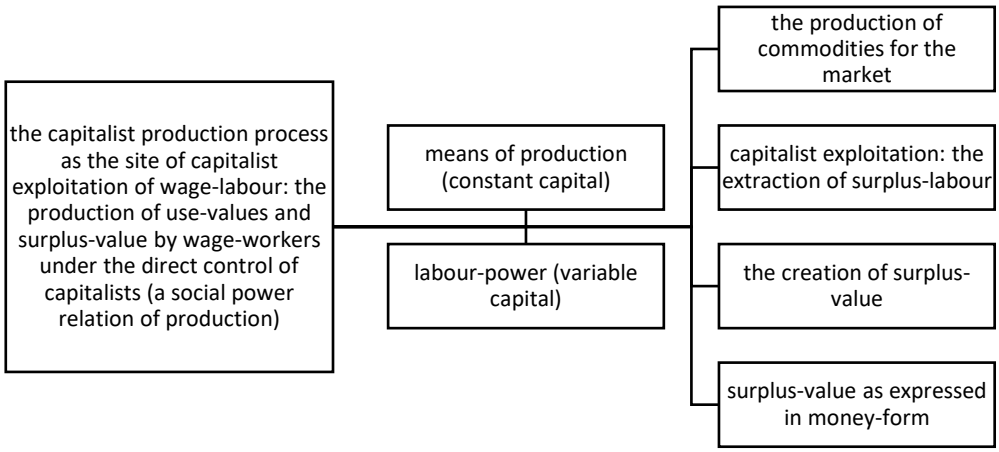
Marx takes this to be the *methodological* move from the level of the appearances of the capitalist mode of production to the level of essence. But in doing so, it must be noted that at the level of the appearances of the capitalist mode of production – i.e., within the sphere of simple circulation and exchange – the exchange relation between the capitalist (the owner of money) and the wage-worker (the owner of labour-power) is seemingly based on a free and equal exchange between two types of commodity-owners. In actual fact, it is not all that free and equal – it is only presumed to be so. If it were really so then there would be some substance to complaints that workers 'conspire together' to raise wages when they form trade unions and have them bargain for them. Nevertheless, this exchange relation between two types of

commodity-owners is based on the fact that there is no explicit coercive pressure that workers face from any individual. This is really how things appear on the surface and is real: hence, it does not reveal the institutional forms of coercion that workers are subject to.

So, in developing his model of the capitalist process of simple circulation and exchange it can be noted that it builds on the model of simple commodity production and circulation by retaining all its essential elements, except with these two crucial differences: (1) the theoretical focus is no longer on the circulation process of commodities by the means of money but its opposite – the circulation process of money by the means of commodities; and (2) it is a shift from buyers and sellers to the relationship between two classes of person. As Marx further analyses the substance of this exchange relation between the capitalist and the wage-worker in the sphere of production, he will do so (as we shall now see) by constructing a highly abstract and idealised model of *a single capitalist production process*; a kind of snap-shot of what essentially goes on in it. For this needs to be done first before he can go on to reveal ultimately the economic law of motion of the capitalist mode of production.

5.2 Revealing a discrepancy between the way things appear on the surface of capitalist society (appearances) and how they essentially are beneath it (essence)

I begin with a graphic representation of the main components which make up Marx's account of the capitalist production process:



Let us first elaborate on this graphic representation of Marx's account of the capitalist production process before considering some issues about what he has revealed about it in this part of Volume 1 of *Capital* (i.e., Part 3).

For capitalists to convert money into capital via the creation of 'surplus-value', they must first combine the labour-power they have purchased in the market from wage-workers in exchange for a wage with the means of production which are in their possession. Briefly, this means that they must get wage-workers to use the means of production (i.e., the machines of the factories, the instruments of labour, the raw materials from which things are made, etc.) to produce things of use. This is for Marx the labour process side of the capitalist production process; it is mainly concerned with the process of producing things which have a 'use-value'.

At this point, Marx (1990: 291) comments that when the 'labour process' becomes 'the process by which the capitalist consumes labour power' it will consequently 'exhibit two characteristic phenomena'. Firstly, 'the worker works under the control of the capitalist to whom his labour belongs' and as a result the capitalist makes sure that 'the work is done' properly and that 'the means of production' are used for the specific 'purpose' of producing useful things without minimal wastage of 'raw material' and 'the instruments of labour' are used economically (Marx 1990: 291). Secondly, that 'the product of labour is the property of the capitalist and not that of the worker, its immediate producer' (Marx 1990: 292). Thus, for Marx, under capitalist conditions of production, the labour process comes under the direct control of capitalists and as a result they come to have ownership rights over the products of labour. This is what the purchase of labour-power legally entails within the capitalist production process. Hence, under such capitalist conditions of production, the wage-worker relinquishes all control over the labour process and rights over the products of labour. In short, they must simply do what they are told by the capitalist, subject to their own property rights in their labour-power, when working with the means of production and accept what they are given by them in the marketplace (a wage in exchange for selling their labour-power). Hence, for Marx, there is a transformation in the exchange relation between 'the owner of money' (the capitalist) and 'the owner of labour-power' (the wage-worker). As Marx (1990: 280) says at the end of Chapter 6 of Volume 1 of *Capital*:

> When we leave this sphere of simple circulation or the exchange of commodities … a certain change takes place … in the physiognomy of our *dramatis personae*. He who was previously the money-owner now strides out in front as a capitalist; the

> possessor of labour-power follows as his worker. The one smirks self-importantly and is intent on business; the other is timid and holds back, like someone who has brought his own hide to market and now has nothing else to expect but – a tanning.

What Marx is consequently bringing out here concerning the labour process under capitalist conditions of production is an exact description of the underlying *social power relation of production* of the capitalist mode of production between the capitalist and wage-worker. What Marx essentially shows is that it is the capitalist, not the wage-worker, who has control over the labour process in terms of how it is used in conjunction with labour-power for a specific purpose. Since the wage-worker possesses nothing else but their own labour-power, and since the only way to earn a living is by selling it to the capitalist in the marketplace for a period for a wage, they consequently come under the direct control of the capitalist too within the production process. As such, they find themselves in a social relationship with the capitalist in which they are subordinate to the latter. Thus, this capitalist social relation of production is one which is based specifically on power: hence, why it is called a 'social power relation of production'.

Marx has therefore revealed a discrepancy between how things appear on the surface of capitalist society in the sphere of simple circulation and exchange between the capitalist and wage-worker and how things really are beneath it concerning their actual social relation in the capitalist production process in terms of freedom and oppression: in the sphere of simple circulation and exchange *the worker appears to be as free as the capitalist* whilst in the other sphere *they are oppressed by the capitalist*. But this is not all that Marx intends revealing about the capitalist mode of production which is focused on a single production process. As we shall see, Marx intends showing that wage-workers are not only oppressed by capitalists in the production process but also exploited. Hence, it is his intention at this stage of Volume 1 of *Capital* to reveal that the social relation between capitalists and wage-workers is essentially both oppressive and exploitative, which in turn means that the capitalist mode of production is, in essence, a system based on the capitalist oppression and exploitation of wage-workers.

To do this, Marx analyses what he calls the valorisation process side of the capitalist production process, which is concerned with the production of 'surplus-value'. This analysis of Marx's (1990: 292) rests on the following core assumption that it is the capitalist and not the wage-worker who has the right to use the labour-power they have purchased from the wage-worker in the market for a certain price:

> [Since] a capitalist pays for a [certain] worth of labour power [,] then the right to use that power for a [certain period of time] belongs to him, just as the right to use any other commodity, such as a horse he has hired for the day. The use of a commodity belongs to its purchaser, and the seller of labour-power, by giving his labour, does no more, in reality, than part with the use-value he has sold. From the instant he steps into the workshop, the use-value of his labour-power and therefore also its use, which is labour, belongs to the capitalist.

These are thus the terms and conditions of the wage-labour contract that has been strucked between the capitalist and the wage-workers they have hired in the market-place.

Given this core assumption, Marx shows by two contrasting examples, based on spinning cotton yarn, how 'surplus-value' is produced within the capitalist production process. These two examples are based on the following assumptions of Marx's:

- It takes six hours of labour to spin 10kg of cotton into 10kg of cotton yarn.
- The cost of 10 kg of cotton is $10.
- The cost for the use (and hence wear and tear) of spindles is $2.
- The cost of purchasing the labour-power of one wage-worker for one twelve-hour day is $3.

In order to spin cotton into yarn, according to Marx, a capitalist must first purchase the raw material of cotton (from which the yarn is spun), the instruments of labour in terms spindles (as these are the tools by which cotton is spun into yarn) and the labour-power of wage-workers (as it requires the labour of wage-workers to spin cotton into yarn with spindles).

In the first example, the capitalist purchases 10kg of cotton at $10 worth so they can produce 10kg of cotton yarn to be sold in the market. They also purchase $2 worth of spindles and pay $3 for the labour-power of one wage-worker for one twelve-hour day so the job of spinning 10kg of cotton into 10kg of cotton yarn can be done. Thus, this capitalist has spent a total of $15 on the raw materials of production (cotton), the instruments of labour (spindles) and the commodity sold to them by the wage-worker (their labour-power). Now, as Marx points out, it only takes the wage-worker six hours to spin 10kg of cotton in 10kg of cotton yarn. So, at this point, the final product of the cotton yarn has been produced and is ready to be taken to the market to be sold. Now, what the capitalist finds when they come to sell the 10kg of cotton yarn in the market is that they only get back the amount which it originally cost them to produce

it for the market - $15 worth. For Marx, all costs of producing 10kg of cotton yarn goes into it. However, from the perspective of the capitalist, they have not made any money on their original investment, which means of course that they have not converted their original amount of money into capital (more money) by the creation of 'surplus-value'. Thus, for Marx (1990: 297), this 'capitalist stares in astonishment' as the 'value of the product is equal to the value of the capital advanced'.

It is notable that while this capitalist has failed to convert their money into capital, the wage-worker who has been employed by the capitalist to spin 10kg of cotton yarn in six hours, has nevertheless been paid for their labour-power. From their perspective, everything is okay as they have been paid exactly what they sold their commodity of labour-power for - $3 worth for one twelve-hour day of labour. As a result, they have earnt enough money in terms of wages to cover the daily costs of their living.

So how, according to Marx, is this capitalist going to convert their money into capital (more money) via the creation of 'surplus-value'? The answer is given by Marx in his second example of spinning cotton yarn.

In this example, on the core assumption that the capitalist has bought the labour-power of a single wage-worker for one twelve-hour day, Marx says that while the wage-worker may need only work for six hours to cover the costs of hiring them for the day, it does not follow that this prevents them from working another six hours – i.e., from working an entire twelve-hour day. As Marx (1990: 300) says: 'The fact that half a day's labour is necessary to keep the worker alive during 24 hours does not in anyway prevent him from working a whole day.' And this is what the capitalist, as Marx (1990: 301) points out, recognises: 'The owner of money has paid the value of a day's labour-power; he therefore has use of it for a day, a day's labour belongs to him.' Thus, for Marx (1990: 301):

> On the one hand the daily sustenance of labour-power costs only half a day's labour, while on the other hand the very same labour-power can remain effective, can work, during a whole day, and consequently the value which its use during one day creates is double what the capitalist pays for that use; this circumstance is a piece of good luck for the buyer, but by no means an injustice towards the seller.

So, in this second example, what we find is that the wage-worker, who has been employed for a one twelve-hour day, spends the next six hours of their work-day spinning another 10kg of cotton into 10kg of cotton yarn with spindles. In terms of costs to this capitalist, all they are

paying for in this second six-hour part of the working-day is another $10 for 10kg of cotton (the raw material of production) and an extra $2 for wear and tear of the spindles (the instruments of labour). What they do not pay for in this other six-hour part of the working-day is the labour-power of this single wage-worker, since this has already been paid, i.e., the capitalist has already paid for it by purchasing it for $3 worth of money. So, when this capitalist goes to market to sell 20kg of cotton yarn, they will be able to sell it for $30 worth of money. But in doing so, they will pocket a difference of $3. As a result, this capitalist would have successfully converted their original amount of money of $27 into a greater amount of money of $30, thereby converting money into capital (more money) via the creation of 'surplus-value'.

How has this actually all happened? Very simply, it has happened by prolonging the working-day of this single wage-worker beyond that point at which they simply reproduce the 'value' of all the components that have gone into the spinning of cotton yarn – cotton, the spindles and labour-power – to that point at which they create 'surplus-value'. As Marx (1990: 302) says:

> If we now compare the process of creating value and the process of valorization, we see that the latter is nothing but the continuation of the former beyond a definite point. If the process is not carried beyond the point where the value paid by the capitalist for the labour-power is replaced by an exact equivalent, it is simply a process of producing value; but if it is continued beyond that point, it becomes a process of creating valorization.

There are two notable points here. Firstly, according to Marx (1990: 301-2):

> … the laws governing the exchange of commodities have not been violated in any way. Equivalent has been exchanged for equivalent. For the capitalist as buyer has paid the full value of each commodity, for the cotton, for the spindle and for the labour-power …

Secondly, for Marx (1990: 303), the capitalist has taken 'good care to buy labour-power of … normal quality', for:

> It must be expended with the average amount of exertion and the usual degree of intensity; and the capitalist is as careful to see that is done, as he is to ensure that his workmen are not idle for a definite period, and he insists on his rights. He has no intention of being robbed.

Thus, for Marx, this is how the capitalist converts their original amount of money into capital (more money) by the creation of surplus-value. It is done via the wage-worker's surplus labour component of the work-day.

Having shown how surplus-value is created by the surplus labour of the wage-worker within an average 12-hour work-day, Marx now develops a conceptual framework in which this account of surplus-value creation can be put. The main point is to develop a theoretical apparatus which can measure what Marx (1990: 320) calls 'the rate of surplus-value' and also 'the degree of exploitation of labour-power' that it reflects.

First, Marx draws a distinction between 'constant capital' (i.e., the means of production) and 'variable capital' (i.e., labour-power). Each of them possesses a 'value' component which Marx expresses in monetary terms (like dollars and cents) and they are both represented, respectively, by the symbols *c* and *v*. In addition, Marx also introduces another two concepts: that of the initial capital advanced at the beginning of any production process in monetary form (which is designated by the symbol *C*) and that of 'surplus-value' itself (which is designated by the symbol *s*). Based on all these symbols and what they each signify, Marx first constructs the following formula:

$$C = c + v$$

This initially means, in monetary terms, that the capital which the capitalist initially advances at the beginning of the capitalist production process is equivalent to how much is spent respectively on the means of production and labour-power. For example, if a capitalist spends $50 on buying means of production and $50 on buying labour-power at the beginning of the production process, then they have spent $100 on their initial capital at the beginning of the production process.

Now, for Marx, what the capitalist needs to do with their initial capital or money is to create 'surplus-value', so they can convert their initial capital or money into more capital or money. (It needs to be clarified that capitalists do not themselves consciously seek to create 'surplus-value'; rather, what they simply seek to do is to make more money in the form of profits.) However, as Marx points out, this cannot be done through the constant component of their capital (the means of production) as this does not, unlike its variable component (labour-power), create any 'value'. Since this is the case, according to Marx, it must be done (as we have already seen) by getting wage-workers to perform what he calls 'surplus labour' or 'surplus labour-time', which is labour or labour-time over and above the amount of 'necessary

labour' or 'necessary labour-time' that the wage-worker must perform to cover the monetary costs of their own labour-power, which is determined by the average living-costs of wage-workers. For instance, if they are paid $50 per week which is sufficient to cover the average living-costs of wage-workers, then this is what they must cover by their 'necessary labour' or 'necessary labour-time' component of the workday.

So, in terms of the above concepts and their respective symbols, this can be expressed by the following formula:

$$C = c + v + s = C',$$

where the symbol C*'* signifies increased capital or more money at the end of the capitalist production process than there was at beginning of it by the creation of 'surplus-value'. Now, to just illustrate the fact that no 'surplus-value' has been created in the capitalist production process and therefore no increased capital or more money has been produced at the end of it, back in the sphere of the simple circulation and exchange process (the market), let us put this symbolic formula in monetary terms:

$$\$100\ (C) = \$50\ (c) + \$50\ (v) + \$0\ (s) = \$100\ (C).$$

If this is the outcome for the capitalist at the end of the capitalist production process – wherein their initial capital or money has not been converted into more capital or money via the creation of 'surplus-value' back in the sphere of the simple circulation and exchange process (the market) – then Marx concludes that this is because the wage-workers who have been employed to perform labour in the production process under the direct control of the capitalist have not produced any surplus labour or surplus labour-time, which is what they must do if they are to create the 'surplus-value' that will allow the capitalist to convert their money into capital. So, the above monetary example illustrates this fact about the lack of any 'surplus labour' or 'surplus labour-time' being performed by wage-workers in the capitalist production process.

However, in the next example of the above formula, this is not the case:

$$\$100\ (C) = \$50\ (c) + \$50\ (v) + \$50\ (s) = \$150\ (C').$$

As can be seen here, $50 of 'surplus-value' has been created in the capitalist production process. This consequently means that the hired wage-workers have performed 'surplus labour' or 'surplus labour-time', the basis of 'surplus-value' creation in the capitalist production process. Consequently, the capitalist has successfully converted their initial capital or money

outlaid on the capitalist production process into more capital or money back in the sphere of simple circulation and exchange (the market). (It should be noted that Marx assumes within this model of a single capitalist production process that all commodities are sold in the market at their value.)

For Marx what this all illustrates is that it is possible to measure the rate of surplus-value in numerical or monetary terms. Thus, for Marx, the rate of surplus-value can be a basic measurement of how much surplus-labour has been performed by a wage-worker in order to create the surplus-value that is needed for a capitalist to convert their advanced capital into increased capital. As a result, it can also be a basic measurement of what Marx calls 'the degree of exploitation of the labour-power' of the wage-worker. For it is Marx's view (as I am about to show) that when a capitalist makes a wage-worker do surplus labour in order to create the surplus-value that is needed to convert their money into capital, they are in fact exploiting them.

The above account of how surplus-value is produced by the surplus labour of wage-workers within the capitalist production process is taken to be by Marx a description of capitalist exploitation of wage-workers. Since this is the case, let us clarify what Marx means by his notion of exploitation and how 'capitalist exploitation of wage-workers' is a specific form of it.

At one point in the chapter in which he first uses the term 'exploitation' in relation to the labour-power of the wage-worker (i.e., Chapter 9 of Volume 1 of *Capital*), Marx (1990: 325) says that:

> What distinguishes the various economic formations of society – the distinction between for example a society based on slave-labour and a society based on wage-labour – is the form in which this surplus labour is in each case extorted from the immediate producer, the worker.

This is an important passage as it highlights that each mode of production which is based on the exploitation of its direct producers (its workers) has its own specific form or method by which the surplus labour of workers is extorted out of them. So, the way the surplus labour of wage-workers is extorted out of them by capitalists is different to how it is extorted out of slaves by their slave-owners or how it is extorted out of land-tenants (or serfs and peasants) by their landlords. While these are all instances of 'exploitation', they differ in the way it occurs. Let us expound on these similarities and differences, which will consequently allow us to grasp both Marx's general notion of exploitation and his specific notion of capitalist exploitation

better. I shall base this discussion on Marx's account of the various forms of exploitation as expounded by him in Chapters 10 and 19 in Volume 1 of *Capital*, plus sections of its appendix ('Results of the Immediate Process of Production').

In slave society, like in ancient Greece or ancient Rome, we have slaves being the property of their slave-owners. As a result, they are not free to do their own things, nor are they free to run away from their slave-owners. They are not able to do either of these things because of fear of punishment or even death. Now, under this slave-master relationship, the slave-owner extorts or extracts surplus labour out of them by threat of physical force on their bodies. As a result, they thus perform the surplus labour that is required of them in order to produce both the products that the slave-owner wants for their immediate and/or long-term consumption such as from working the fields to produce crops to building their homes, etc. and providing services of all sorts such as domestic and sexual services. Thus, under the 'brutal lash' of the slave master, as Marx says, the slave-owner can extract or extort surplus labour from their slaves. Of course, as Marx points out, the slave does not just work for the slave-owner only; they must also spend some time performing what Marx calls necessary labour for themselves, i.e., labour which needs to be done in order to reproduce themselves even at a menial level (bare subsistence). Marx points out that this division between the necessary labour and the surplus labour of slaves is largely obscured by the appearance that all the labour of slaves is surplus labour, labour that is performed solely for the benefit of their masters (the slave-owners) – i.e., it is obscured by the way all labour appears as surplus labour under slavery. This is, as Marx points out, the inverse of capitalism wherein it appears that all the labour of wage-workers is necessary labour rather than also surplus labour: hence, under capitalism there is a division between the necessary labour and the surplus labour components of the work-day.

In feudal society, however, which is based on the social relation of landlords and tenants (or serfs, peasants, etc.), we have a clear and noticeable division between the necessary labour of tenants (labour which is done for themselves in order to reproduce themselves) and the surplus labour they perform for their landlords. This division between the necessary and surplus labour components of the week is clearly transparent for all to see. It will be seen that the tenants spend three days a week working for themselves and three days a week working for their landlords, with Sunday off for religious reasons. Now, under this socio-economic arrangement, the surplus labour of tenants which is what their landlords required of them in order to maintain and reproduce their own existence (such as tilling their land, growing their crops, collecting fallen wood from the forests, etc.) is extorted out of them, ultimately by threats of punishment

by death. Under this social arrangement, there is a kind of forced obligation: for the tenant to be protected, etc., then they must provide surplus labour for the benefit of the landlord, otherwise the landlord will not protect them, etc.

Now, what can be noted here is that in both cases of ancient slavery and feudalism there is (1) a division between the necessary and surplus labour of the 'worker's' day, (2) that the necessary labour is done for the benefit of the 'worker' themselves while the surplus labour of the 'worker' (slave or tenant) is done for the benefit of the 'master' (slave-owner or landlord), and (3) the surplus labour of the 'worker' is in each case extorted or extracted out of them by different means (direct physical threats to their well-being or being expelled from their land).

It needs noting that in the case of feudalism, the surplus labour of the tenant is not compensated for by the landlord. They are not paid in any way for this work. It is something that they are forced to give as a result of the different circumstances that they find themselves in for free. Marx (1990: 671-72) calls this type of so-called free labour 'unpaid, forced labour' – i.e., labour that is forcibly given for free or nothing in return (i.e., *gratis* labour). Marx, as we shall see, wants to say that the surplus labour of wage-workers is also '*gratis* labour' – something that is forcibly given for free or for nothing in return.

It should be noted that the essential difference between the slave and tenant is that the former is completely unfree while the latter is free in the sense of not being the personal property of the landlord. In this sense, the tenant has more in common with the modern wage-worker, although Marx says that workers are still 'wage-slaves' – which suggests that, like slaves, they presumably 'slave away' for the benefit of the capitalist. As Marx says, the modern wage-slave is free to work for any capitalist, but they are not free to work for no capitalist at all.

Now, what these two contrasting examples in ancient slavery and feudalism illustrate for Marx is that when we talk about 'exploitation' and make the charge that the slave-owner/slave relation and the landlord/tenant relation are both forms of 'exploitation', what we have in mind is a situation in which the exploiter (the slave-owner and the landlord) exploits the exploited (the slave and land-tenant) because they have power over them as a result of the vulnerable or weak situation in which the exploited stands in relation to them. The exploited fear the consequences of not doing the surplus labour that their exploiter demands of them. Because of this fear factor, the exploiter is thus able to extort out of the exploited surplus labour for nothing. And furthermore, Marx wants to say that this actual exploitative relation between the exploiter and the exploited is coercive. The exploited is being coerced or forced into working

for the benefit of the exploiter: they have no choice given the vulnerable or weak situation in which they find themselves in relation to the exploiter. For Marx, this is what the general notion of exploitation basically entails.

Now, when it comes to 'capitalist exploitation', Marx also wants to say that capitalists take advantage of the vulnerable or weak situation that wage-workers find themselves in as result of not owning any means of production but only their labour-power, which they need to sell if they are to earn a living-wage – otherwise they face being unemployed and in relative poverty. In addition, Marx wants to say that this particular exploitative relation is, like that of the slave-owner/slave relation and the landlord/tenant relation, a coercive one too since wage-workers have no choice given the vulnerable or weak situation they find themselves in relative to the capitalist.

This, then, is what Marx basically takes exploitation to be in general (as based on the examples of ancient slavery and feudalism) and capitalist exploitation in particular. But Marx also wants to say something much more exact about the actual relation between the phenomenon of capitalist exploitation of wage-workers in the capitalist production process and the capitalist economic system itself. It is this. *Capitalism is an economic system which works on the basis of one class of persons (capitalists) systematically exploiting another class of persons (wage-workers) in order to make profits: that is, it is an economic system in which one class of persons (capitalists) systematically takes advantage of the vulnerability of another class of persons (wage-workers) in order to extort something out of them (surplus labour) for their own financial benefit (to make capitalist profits).* Thus, for Marx, capitalism is not an economic system in which some capitalists, but not all, may exploit wage-workers in the capitalist production process. For Marx, as we shall see (later on in the chapter), it is a structural feature of the capitalist mode of production: capitalism cannot be what it is and develop in the ways that it does if there is no actual capitalist exploitation of wage-workers within the capitalist production process. It is at the heart of the capitalist economic system.

Having shown how, according to Marx, capitalists exploit wage-workers in the production process, which is the basis of creating surplus-value, let us briefly consider what is the *real drive* of the capitalist production process and how this is done: the production of what Marx calls 'relative surplus-value'. In doing so, we are still dealing with Marx's analysis of the capitalist mode of production as *a single production process*. This consequently means that Marx's model of the capitalist mode of production is *still* at a very abstract and highly idealised

stage of presentation in Volume 1 of *Capital*. In short, his model of the capitalist mode of production at this stage is one which both leaves out what is not essential to his analysis of it and which is, at the same time, not a literally true description of it (the capitalist mode of production is not a frozen, static single production process but rather, as we shall see, a dynamic system in motion).

5.3 The different methods of how capitalists extract relative surplus-value out of wage-workers in the capitalist production process

First, a brief explanation of what Marx means by 'relative surplus-value'. For Marx, it simply refers to the process of reducing the amount of necessary labour-time of the wage-worker in the production process to the minimum (which their wage-bundle represents) so they may then spend the rest of their time performing the maximum amount of surplus labour-time (or surplus labour), which means basically being very 'productive' as a worker. It consequently differs from 'absolute surplus-value' in that the latter represents simply the absolute amount of surplus labour-time the wage-worker can perform in the production process daily: there are physical and mathematical limits to how much surplus labour-time they can do (the wage-worker can only physically work for so long and there is only 24 hours in the work-day anyway).

This distinction of Marx's (1990: 340 and 431) between the two types of surplus-value can thus be illustrated via the following examples of a work-day which is divided between necessary labour-time (A-B) and surplus labour-time (B-C). In a normal 10-hour working-day, we have an even division between necessary labour-time and surplus labour-time, in which the wage-worker spends the first half of the work-day performing necessary labour for themselves (5 hours), while in the second half doing surplus labour for the capitalist (which is the source of the surplus-value which converts their money into capital):

A----------B----------C

Now, there are two methods by which the capitalist can make the wage-worker do surplus labour and consequently create the surplus-value that is needed in order for the capitalist to convert their money into a greater amount of capital (a greater amount of money). The first method is by extending or prolonging the work-day by an extra five hours without any financial compensation to the wage-worker (extra wages for doing overtime):

A----------B---------------C

Under this scenario of a prolonged 15-hour work-day, the wage-worker spends the first part of the work-day doing 5 hours of necessary labour for themselves, while in the second part they do an extra 5 hours of surplus labour for the capitalist, which means that they come to do a total of 10 hours of surplus labour for the capitalist. As a result, they produce ten hours' worth of surplus-value for the capitalist, which consequently means they can convert their money into a greater amount of capital (a greater amount of money). This example illustrates what Marx means by *the production of absolute surplus-value*: it is generated by making the wage-worker perform extra surplus labour by simply extending the normal 10-hour work-day by an extra 5 hours (as in this case).

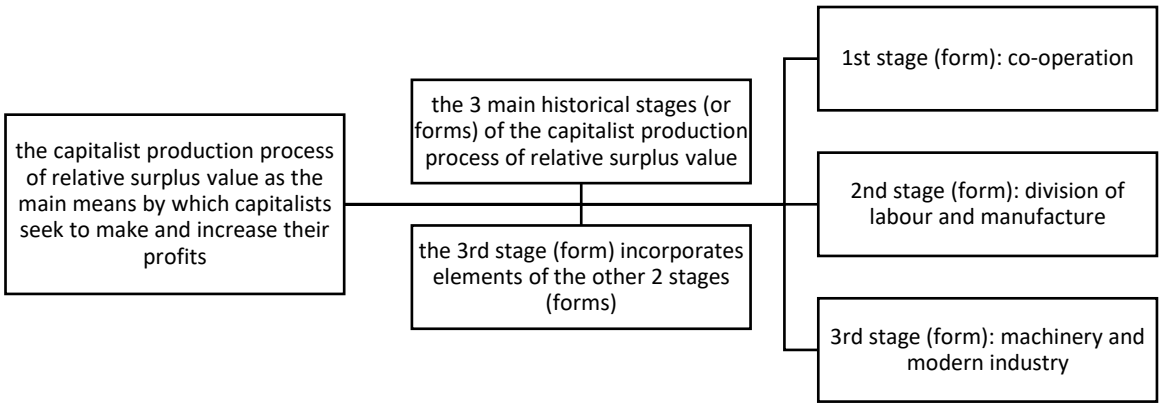
With respect to the production of relative surplus-value, the capitalist does not achieve this by extending or prolonging the normal 10-hour work-day (although they could of course and probably do, with or without any compensation to the wage-worker in extra wages for doing overtime). Instead, the capitalist achieves this by a method which consequently reduces that part of the work-day that is devoted to the wage-worker doing necessary labour for themselves (i.e., labour which is done to cover the 'value' or wage-costs of their labour-power). So, under this second scenario, the wage-worker spends the first part of the work-day doing two hours' worth of necessary labour for themselves before spending the rest of the work-day doing eight hours' worth of surplus labour for the capitalist:

A-----B----------C

As a result, they thus produce eight hours' worth of surplus-value, which in turn allows the capitalist to convert their money into a greater amount of capital (a greater amount of money) than they would have had in a normal 10-hour work-day in which there is an equal division between its necessary and surplus labour-time components.

Thus, as Marx is at pains to show throughout Part 4 of Volume 1 of *Capital*, it is by the second method that the capitalist converts their money into the greatest amount of capital as possible (the greatest amount of money as possible). They themselves are not consciously thinking in terms of how they can get the wage-workers to produce the relative surplus-value which allows them to convert their money into the greatest amount of capital as possible. Rather, they are just thinking in terms of how to get wage-workers to produce more commodities for the market in the most productive way possible so they can hopefully make more profits for themselves at the end of the day.

Without going into all the details of his discussion in Part 4 of Volume 1 of *Capital* concerning the different methods by which relative surplus-value is extracted out of the wage-worker in the production process, let us summarise it by the following graphic:



Brewer (1984: 67), for instance, claims that what Marx does in this part of Volume 1 of *Capital* is present us with a series of historical 'snapshots' of how capitalists have developed new methods of production which allow for the extraction of relative surplus-value, by first appropriating the pre-existing methods of production (as found in the guilds of earlier times) before gradually and then rapidly developing them into industrially advanced methods of production (as exemplified by the factories of Marx's own times). The main theoretical conclusion to draw from this historical discussion of Marx's (which is based on the industrial England of his times) is how the capitalist mode of production itself has developed into a system of production which is based no longer on what he (1990: 645) calls 'the formal subsumption of labour under capital' but the 'real subsumption' of it. By this, Marx means, that under the former system of production the wage-worker labours under the direct control of the capitalist by working with 'the pre-existing techniques of production' to produce 'absolute surplus-value' (Choonara 2017: 135). However, under the latter system of production, they labour under the direct control of the capitalist by working with new and more technically advanced methods of production, which (as Marx points out) is required if capitalists are to convert money into capital (more money) by the production of relative surplus-value. Thus, under the latter system of capitalist production, we have a description of how the capitalist production process necessarily works. In order for capitalists to convert money into capital (more money), wage-workers must produce not just absolute surplus-value

(which, as Marx says, is always a feature of the capitalist production process) but also relative surplus-value. In fact, Marx's main point is that in order for this to happen, then the capitalist must extort as much surplus labour-time out of the wage-worker as possible by reducing the amount of necessary labour-time spent on their own reproduction as a wage-worker; and it is this which generates newer and more technologically-advanced methods of production in the capitalist process of production. For it is through the latter (as Marx argues) that the former is achieved.

On this point, it can thus be noted that the goal of any capitalist in the capitalist production process is to increase the intensity and productivity of the worker's labour in terms of the surplus labour component of the working-day, by simultaneously shortening the working-day of the worker in terms of the necessary labour component of the working-day. As Marx (1990: 666-67) says:

> Increased productivity and greater intensity of labour, both have a similar effect. They both augment the mass of articles produced in a given time. Both therefore shorten that portion of the working day which the worker needs to produce his means of subsistence or their equivalent. … The more the productivity of labour increases, the more the working day can be shortened, and the more the working day is shortened, the more the intensity of labour can increase.

Now, as Marx points out, as the capitalist searches to convert their money into greater amounts of capital (greater amounts of money) through newer and more technologically-advanced methods of production, wage-workers are constantly being displaced by them and consequently made unemployed if they prove to be labour-saving techniques of production. This is an important outcome, although Marx does not discuss how so at this stage of his presentation of the capitalist mode of production. The significance of it, is borne out in what next follows in Part 7 of Volume 1 of *Capital*.

5.4 Revealing the economic law motion of the capitalist mode of production: the underlying essence of the capitalist system (its causal foundations)

I shall now show how, in Part 7 of Volume 1 of *Capital*, Marx reveals the underlying essence of the capitalist mode of production (which is the central aim of his methodological project) in terms of its economic law of motion (which is the central aim of his theoretical project). This

is done by constructing, firstly, two highly abstract and idealised models of the capitalist mode of production as an accumulation process, before, secondly, deriving a set of theoretical conclusions from the analysis of the second model. The first model is that of 'simple reproduction' (a 'circular' model of the capitalist mode of production), while the second one is that of 'expanded reproduction' or 'capital accumulation' (a 'spiral' model of the capitalist mode of production). The set of theoretical conclusions, which are derived from the second model, are then summed up by the 'absolute general law of capitalist accumulation'. Thus, Marx goes from a model of the capitalist mode of production as *a single production process* to a model of it as *a continuous and ever-expanding reproduction process* to then develop *a set of theoretical conclusions* about the capitalist mode of production. Hence, he develops his account of the capitalist mode of production in successive stages of 'approximation'.

Marx constructs this series of 'successive approximations' based on two major simplifying assumptions. Marx's (1990: 710) first assumption is 'that the capitalist sells the commodities he has produced at their value' in the marketplace or sphere of circulation for a certain price without any hold-ups; while the second one is that 'the capitalist producer' is viewed as the sole 'owner of the entire surplus-value, or… as the representative of all those who will share the booty [i.e., the surplus-value] with him' – the financial capitalists who derive a portion of the 'surplus-value' in the form of interests and the capitalist landlords who derive a portion of it in the form of rents. Thus, by making these two simplifying assumptions, Marx (1990: 710) 'disregards all phenomena that conceal the workings of' the 'inner mechanism' of the capitalist mode of production. Hence, this is how Marx seeks to reveal the causal foundations or essence of the capitalist mode of production.

5.4.1 First model: the capitalist mode of production as a simple reproduction process (the process of reproducing the social class relation of capital and wage-labour)

Marx (1990: 711) first says, at the start of Chapter 23 of Volume 1 of *Capital*, that:

> Whatever the social form of the production process, it has to be continuous, it must periodically repeat the same phases. A society can no more cease to produce as it can cease to consume. When viewed, therefore, as a connected whole, and in the constant flux of its incessant renewal, every social process of production is at the same time a process of reproduction.

Thus, it is on this assumption that Marx first analyses the capitalist mode of production *as* a process of reproduction. But what kind of reproduction process is it, that Marx focuses on? In the first instance, it is as a process of *simple* reproduction, as we shall now see.

Marx (1990: 711), firstly, supposes that the 'conditions of production are at the same time the conditions of reproduction'. In other words, the same conditions apply, whether it be at the start of the first production process or at a later, repeated stage of it. What this subsequently involves, Marx (1990: 711) spells out:

> No society can go on producing … [i.e.,] reproduce [itself], unless it constantly reconverts a part of its products into means of production …

So, for Marx (1990: 711), if:

> All other circumstances [remain] the same, the society can reproduce or maintain its wealth on the existing scale only by replacing the means of production which have been used up … with an equal quantity of new articles.

But for this to happen, as Marx (1990: 711) next says, then:

> These must be separated from the mass of the yearly product, and incorporated once again into the production process. Hence a definite portion of each year's product belongs to the sphere of production.

Since, for Marx (1990: 711), this is '[d]estined for productive consumption from' the very start, 'this portion exists, for the most part, in forms which by their very nature exclude the possibility of individual consumption'.

This, then, is Marx's basic model or sketch of a simple reproduction process which can apply to any society or to any mode of production. Consequently, it is in terms of this basic model of a simple reproduction process that Marx first analyses the capitalist mode of production.

Accordingly, for Marx (1990: 711), if the 'production' side of a mode of production 'has a capitalist form, so too will' its 'reproduction' side. Briefly, this involves (as we have seen in the model of a single capitalist production process) wage-workers using the means of production (the instruments of labour, raw materials, etc.) to produce not just commodities but also surplus-value under the direct control of capitalists. Consequently, capitalists pay all their workers a wage as well paying for the use of all the means of production, and their profits come from the surplus-value itself. Now, if the capitalist consumes, as Marx says, all the surplus-

value in the form of profits for their own personal consumption, then this does not imply that there will be no money left over for such a production process to be repeated. If this is the case, however, the capitalist can use the value of their variable and constant capital to keep going but only at the same level as before. If the capitalist does this then the capitalist process of production can be simply reproduced, and if the capitalist does this repeatedly then the capitalist process of production can be continually reproduced in a simple form. Under such a framework of 'simple reproduction' the aim of the capitalist is not to amass greater wealth for themselves after each process of capitalist production; rather, the aim is simply to reproduce enough surplus-value which allows them to not only consume a 'luxury' lifestyle but also, most importantly, to ensure that the whole process of producing commodities and surplus-value can be continuously repeated.

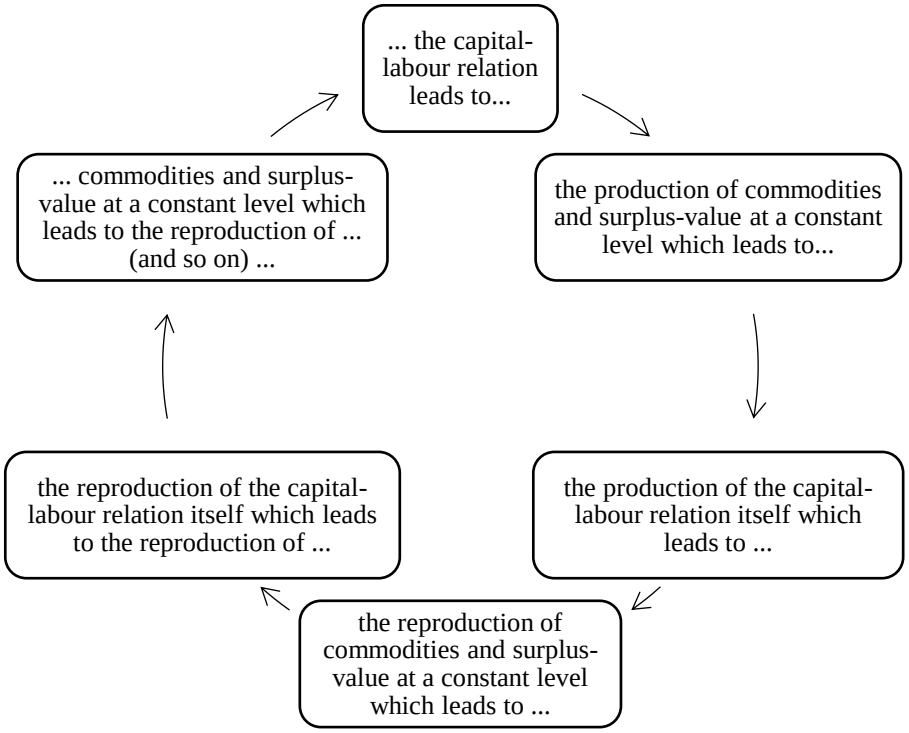
What is important about this capitalist process of simple reproduction is that it is predicated on a specific social power relation of production being in place – a social relation in which not only capitalists possess and control the means of production while wage-workers possess nothing but their own labour-power, but also in which capitalists consequently both exploit and oppress wage-workers. Under this specific social power relation of production, wage-workers are compelled to sell, if they want to live out a daily or weekly existence, their labour-power in the market to capitalists in exchange for a wage after the completion of each single capitalist production process, while, if the capitalist wants to renew each single capitalist production process so they may maintain their luxurious lifestyle, then they must purchase in the market the labour-power of wage-workers in exchange for a wage. This, then, is what the simple reproduction process of the capitalist mode of production is based on.

But this is not the only thing to note here, as Marx points out. In being a simple reproduction process, such a model of the capitalist mode of production necessitates that this specific social relation of production between capitalists and wage-workers be continually reproduced as well. For if, as Marx might say, the production side of such a capitalist mode of production has a specifically capitalist from of a social power relation of production, so too will its reproduction side.

Marx (1990: 724) thus concludes that the:

> capitalist process of production … produces and reproduces the capital-labour relation itself; on the one hand the capitalist, on the other the wage-labourer.

Accordingly, in developing this initial model of the capitalist process of production as a simple reproduction process, Marx (1990: 729) construes it as having a 'circular form'. By this, he means that the capitalist mode of production does not expand in any way in terms of its economic growth. It maintains a 'steady-state' situation. This circular model of the simple reproduction process of the capitalist mode of production can thus be graphically depicted as:



As can be seen here, the capitalist mode of production simply repeats itself at a constant level after each cycle of the production process has finished and consequently moves in a circular form.

5.4.2 Second model: the capitalist mode of production as a process of expanded reproduction (the capitalist accumulation process)

We now turn to Marx's second model of the capitalist mode of production as a reproduction process. This abstract and idealised model of the capitalist mode of production builds on the first one. Like the first model, it too is a model of 'reproduction'. However, unlike the first reproduction model, this one is focused on how the capitalist mode of production reproduces itself on a 'progressively increasing scale' (Marx 1990: 725) by converting surplus-value into capital. This model, like the first one, is also predicated on the social class relation of capital

and wage-labour being constantly reproduced, but with this one crucial difference: the capital/wage-labour relation is 'progressively' reproduced on an 'increasing scale' rather than simply reproduced at a constant level. As always, the following caveat holds: this model is not in all respects a model of how the capitalist mode of production literally works, but it is nevertheless one which gets closer to revealing how it essentially works.

This new model of 'expanded reproduction' (as Marx also calls it) construes that for the individual capitalist to convert surplus-value into capital on a progressively increasing scale then certain conditions, as Choonara (2017: 153) points out, must be satisfied. First, capitalists must be able to find constantly on the market new means of production to replace the old ones when they have been used up. Second, there must always be a sufficient amount of subsistence goods in the market to satisfy the consumption needs of wage-workers, and not just luxury goods for the lifestyle of capitalists. And third, capitalists must be able to find always on the market additional labour-power to employ with the means of production, whenever the need to do so arises (as when there is a greater demand for certain commodities). If all these conditions are satisfied, then according to Marx the capitalist will be able to constantly convert surplus-value into capital on a progressively increasing scale. As Marx (1990: 729) says: 'The more the capitalist has accumulated, the more he is able to accumulate'. Thus, for Marx, not only will capitalist accumulation occur but the capitalist mode of production itself will transform itself from a state of *simple reproduction* to one of *constant reproduction on a progressively increasing scale*. As such, it will no longer move or develop along a circular path but, as Marx (1990: 727) says, as 'a spiral'. This, then, is the upshot of the capitalist's drive to constantly convert surplus-value into capital on a progressively increasing scale.

However, as Marx (1990: 739) points out, this all happens because of competition itself:

> … competition subordinates every individual capitalist to the immanent laws of capitalist production, as external and coercive laws. It compels him to keep extending his capital, so as to preserve it, and he can only extend it by means of progressive accumulation.

This is, it should be noted, not the first time Marx invokes the concept of competition in Volume 1 of *Capital*. He already invokes it in the very long chapter on the working-day which is concerned with the 'class struggle' between the capitalist class and the working class over the length and working-conditions of the working-day. In a particular passage wherein Marx (1990: 381) says that '*Après moi le déluge!* [After me, the flood!] is the catchword of every

capitalist and of every capitalist nation', it is nevertheless under 'free competition' that 'the immanent laws of capitalist production confront the individual capitalist as a coercive force external to him'. Marx also invokes it in the passage on the Copernican-Newtonian analogy of science, as quoted in the last chapter. Marx also invokes it (although he does not actually use the word itself) in the chapter on machinery and large-scale industry which is concerned with how, through the development of new and better forms of labour-saving machinery and methods of production, capitalists can not only displace wage-workers from the production process (i.e., 'chuck them out of a job') but also make them work harder and for longer periods of time for less money in terms of wages. As such, Marx (1990: 582) says:

> Except in periods of prosperity, a most furious combat rages between the capitalists for their individual share in the market. This share is directly proportional to the cheapness of the product. Apart from the rivalry this struggle gives rise to in the use of improved machinery for replacing labour-power, and the introduction of new methods of production, there also comes a time in every industrial cycle when a forcible reduction of wages beneath the value of labour-power is attempted so as to cheapen commodities.

And Marx also does it (as we shall soon see) in the chapter on the absolute law of capitalist accumulation which is concerned with revealing the fundamental economic law of motion of the capitalist mode of production. In this chapter Marx (1990: 777) says that:

> The battle of competition is fought by the cheapening of commodities. The cheapness of commodities depends … on the productivity of labour, and this depends in turn on the scale of production. Therefore the larger capitals beat the smaller.

Thus, as can be seen here, Marx invokes the concept of competition not as a concept which just refers to price competition between capitalists in the market (which is the focus of modern orthodox neoclassical economics), but as one which also focuses on the actual competition which exists between capitalists within the sphere of production itself (as Shaikh (2015), for example, also makes clear in his recent book on capitalism). Capitalists, in their effort to compete with one another in the market in terms of price competition (selling their commodities as cheaply as possible) are also competing with one another in the sphere of the production process. They are all competing with each other to come up with better forms of labour-saving machinery and methods of production in order to cheapen the prices of their

products (commodities) which they hope to sell in the market. In invoking the concept of competition in this way, Marx is thus indicating that competition between capitalists occurs in two different spheres of the capitalist mode of production: in the sphere of circulation and exchange (the capitalist marketplace) and in the sphere of production (the capitalist production process). As such, the phenomenon of capitalist competition is something which not only belongs to the appearances but also the essence of the capitalist mode of production. For Marx, while both spheres of the capitalist mode of production are different, they are nevertheless (as shown in the last chapter on Marx's distinction between appearance and essence) mutually dependent on one another.

With Marx's concept of competition clarified, we can consequently say that competition between capitalists is what drives them all to accumulate more wealth for themselves by continuously converting surplus-value into capital on a progressively increasing scale, which means (as just pointed out) that they must compete with each other in the sphere of the capitalist production process to develop better techniques of production. It is what compels them all to endlessly accumulate if they are not to perish and remain economically competitive within the marketplace. As Marx (1990: 742) says, it is the task of capitalists to 'Accumulate, accumulate!' – meaning that they must 'Save, save, i.e. reconvert the greatest possible portion of surplus-value or surplus product into capital! Accumulation for the sake of accumulation, production for the sake of production'. Hence, capitalist accumulation is revealed as a *necessity* of the capitalist economic system, as pointed out by Choonara (2017: 155). If there is no capitalist accumulation, then not only will individual capitalists cease to increase their wealth on a progressively increasing scale but the capitalist mode of production itself would cease to expand on a progressively increasing scale. This is what this latest highly abstract and idealised model of Marx's has essentially revealed about any society which is based on the capitalist mode of production.

Marx is sometimes criticised for not starting with competition, as illustrated by for example Samuelson's (1970 and 1971) two papers on Marx's so-called transformation problem. In these two papers, Samuelson (1970: 423; and 1971: 399 and 419) suggests that Marx should have begun his analysis of the capitalist mode of production at the level of price competition between rival capitalists (i.e., 'competitive "prices"'), which is what is done by 'conventional economic theory' as based on the Walrasian theory of general equilibrium prices (i.e., modern orthodox neoclassical economics), rather than at the level of how capitalists exploit wage-workers in the capitalist production process in terms of his theory of surplus-value. That is, he should have

begun his analysis of capitalism with Volume 3 of *Capital* (the sphere of circulation) rather than with Volume 1 (the sphere of production). This is because, for Samuelson (1971: 415), the former is not only far more 'realistic' than the latter but also far more fundamental for 'understanding' how 'competitive "prices"' are generated through competition amongst capitalists. As such, Samuelson (1971: 418 and 421) claims that Marx made an 'unnecessary detour' in starting an analysis of capitalism based on how wage-workers are exploited by capitalists in the capitalist production process.

As is also well known, these two papers of Samuelson's (1970: 421) lay the basis for a rejection of Marx's theory of capitalism as based on his theory of surplus-value by showing what is purportedly wrong with his so-called method of '"transforming" from values into prices'. According to Samuelson (1971: 400), what Marx effectively does is this:

> "Contemplate two alternative and discordant systems. Write down one. Now transform by taking an eraser and rubbing it out. Then fill in the other. *Viola!* You have completed your transformation algorithm."

But according to Samuelson (1971: 400), Marx is wrong to have done this as it means you can, by this write-and-erase method, 'transform' anything you like without having any justified grounds (whether mathematical or logical) for doing so. Consequently, for Samuelson (1971: 400):

> By this technique one can "transform" from phlogiston to entropy; from Ptolemy to Copernicus; from Newton to Einstein; from Genesis to Darwin – and, from entropy to phlogiston …

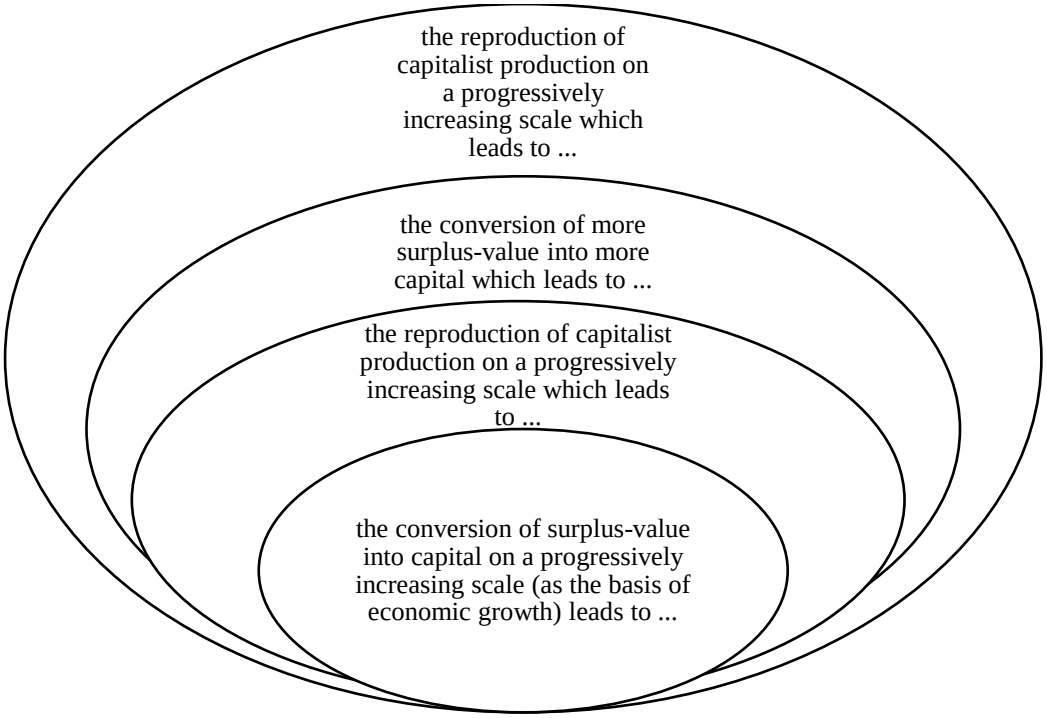
Thus Samuelson provides a technical and/or mathematical argument for rejecting Marx's starting point for an analysis of the capitalist mode of production at the level of capitalist exploitation of wage-workers within the sphere of production rather than at the level of price competition within the sphere of circulation and exchange.

However, as Marx says in the passage about 'competition' and the 'heavenly bodies' (see section 4.2 of the last chapter) that before we can give a scientific analysis of capitalist competition, we must first comprehend the 'inner-nature' of capital itself. For it is only on this scientific basis that we can then comprehend what goes on in capitalist competition. This means therefore that we must first understand how capital is produced (i.e., by capitalist exploitation) and then how it in turn produces (i.e., how it is used by capitalists to produce and reproduce

the conditions for capitalist accumulation), notwithstanding the fact that this all occurs as Marx says within the arena of capitalist competition itself. Once all this theoretical work is done, then we are in a position to give a scientific analysis of what goes on in capitalist competition. This theoretical approach of Marx's is consistent with his methodological views about essence and appearance. Before we can understand the appearances of things – how things appear outwardly on the surface of things – we must first uncover their underlying essence – that which is their causal foundation. This is, as we have seen, not just a Hegelian perspective but also a Lockean one. And moreover, it is the position of contemporary scientific realism which holds that for science to understand the observable phenomena of the world then it must first uncover the hidden causal structures which in turn give rise to them. This seems a perfectly rational approach – as exemplified in the scientific work of Newton in the *Principia*.

Now, as Marx further points out, there are at least two methods by which, as Choonara (2017: 156) says, the 'pace of accumulation' can be maintained, i.e., the pace at which capitalists under competitive conditions strive to convert surplus-value on a progressively increasing scale. On the one hand, it can be maintained by increasing the rate of surplus-value by increasing the degree of capitalist exploitation of wage-workers within the capitalist production process. This can be done in one of two ways. First, by pushing the wages of workers below the 'value' of their labour-power, i.e., beneath the costs of reproducing themselves on a daily average (Choonara 2017: 156). And second, by simply employing more wage-workers and making them work longer hours daily (Choonara 2017: 156). On the other, it can be done by simultaneously increasing the level of 'labour productivity' of wage-workers overall, i.e., by making them produce more products per hour without any changes to their hourly-wage, while reducing the costs of the use of the means of production (Choonara 2017: 156-7).

This account of Marx's 'spiral' model of the constant reproduction of the capitalist mode of production on a progressively increasing scale can thus be graphically represented as:



This is how the wealth of those societies which are based on the capitalist mode of production is created. This is not immediately apparent on the surface of capitalistic societies (Marx's starting point at the beginning of Volume 1 of *Capital*). It has taken Marx the first twenty-four chapters of Volume 1 of *Capital* to reveal this. However, he has not yet completed his scientific analysis of the capitalist mode of production. What is missing is his account of the *causal mechanism* which drives the entire capitalist mode of production; its *underlying essence* factor. This, Marx now rectifies by his analysis of the underlying economic law of motion of the capitalist mode of production in Chapter 25 of Volume 1 of *Capital*. In doing so, Marx completes his joint projects in his critique of political economy in Volume 1 of *Capital*: his methodological project of uncovering the essence of phenomena hidden behind their appearances and his theoretical project of revealing the economic law of motion of the capitalist mode of production.

5.4.3 Marx's analysis of the economic law of motion of the capitalist mode of production ('*the absolute general law of capitalist accumulation*'): his theoretical conclusions

Marx's task at this stage of his highly abstract and idealised model of the capitalist mode of production is to draw some theoretical conclusions about the capitalist mode of production on the basis of his second model. In doing so, he finally reveals what must essentially be in place if the capitalist mode of production is to constantly reproduce itself on a progressively

increasing scale. As such, Marx comes the closest to capturing how any society which is based on the capitalist mode of production both works and develops.

But first, let us recap the essential elements Marx has so far established about the capitalist mode of production as a process of reproduction:

1. Each simple reproduction process reproduces the capital/wage-labour relation as a social class relation via the production of commodities and surplus-value; and
2. Each expanded reproduction process constantly reproduces itself on a progressively increasing scale via the conversion of surplus-value into capital.

What Marx next must show is how this all happens: *what the fundamental mechanism of the capitalist mode of production is*. Marx (1990: 762) does this by considering the impact of 'the growth of capital on the fate of the working class'.

Before considering how, according to Marx, 'the growth of capital' affects 'the fate of the working class', we first need to clarify the underlying aim of this chapter in Volume 1 of *Capital*. In this chapter, it is Marx's aim to uncover the essential factors which enables actual *growth in capital* to occur in terms of progressively expanding capitalist profits (capitalist wealth). This particular aim is, in turn, connected to Marx's ultimate aim in Volume 1 of *Capital*, which is to reveal the *economic law of motion* of the capitalist mode of production – the very causal mechanism which ensures that the capitalist mode of production reproduces itself on a progressively expanded scale. It is for this reason that Marx focuses on the effects of the 'growth of capital' on the 'fate of the working class'.

To analyse the effects of 'the growth of capital' on 'the fate of the working class', Marx (1990: 762) does so in terms of what he calls (1) 'the composition of capital' and (2) 'the changes it undergoes in the course of the process of accumulation', i.e., in terms of the process of reproducing capitalist profits or wealth on a progressively extended scale via capitalists constantly reinvesting a proportion of their profits or wealth into the production process in order to make greater profits and thereby increase their wealth. Since this is so, we need to briefly explain what Marx means by the 'composition of capital'. According to Marx (1990: 762), capital is composed of two connected parts: a 'value' part and a 'material' part. The *value part* refers to the distinction between what Marx (1990: 762) calls 'constant capital', i.e., 'the value of the means of production', and 'variable capital', i.e., 'the value of labour-power'. The *material part* refers to the distinction between 'means of production' and 'living labour-power',

i.e., between ‘the mass of the means of production employed’ in any production process and ‘the mass of labour necessary for their employment’ in any production process (Marx 1990: 762). Marx (1990: 762) calls these two respective parts of capital its ‘value-composition’ and its ‘technical-composition’. Accordingly, for Marx (1990: 762), there is ‘a close correlation’ between these two parts of the composition of capital, in that the value-composition of capital is not only ‘determined by’ the technical-composition of capital but also, at the same time, ‘mirrors the changes’ in the technical-composition of capital itself. Consequently, to express this close connection between the two parts of the composition of capital, Marx (1990: 762) calls the value-composition of capital also ‘its organic composition of capital’. So, to analyse how ‘the growth of capital’ affects ‘the fate of the working class’ Marx focuses on the changes in the technical-composition of capital which is mirrored by its value-composition. This is also the method by which Marx (1990: 781) establishes how capitalism, on the basis of its underlying social structure (the social power relation of capitalists and wage-workers), constantly produces what he calls ‘a relative surplus population or industrial reserve army’ of unemployed wage-workers and that unemployment is consequently a necessary structural feature of the capitalist economic system itself in that the latter cannot be what it is and develop in the way it does without it.

In analysing how the growth of capital affects ‘the lot’ of the working class (i.e., its economic fate), Marx does so, as Harvey (2010: 263) claims, via a presentation of two different models of capital accumulation. In the first model of capital accumulation, Marx (1990: 763) focuses on how growth in capital ‘implies’ at the same time ‘growth of its variable constituent’, i.e., a growth in that part of capital which is ‘invested in labour-power’. While in the second model, Marx focuses on how the growth of capital results in a reduction in the growth of its ‘variable constituent’, i.e., labour-power, and therefore a decrease in the investment of it.

Concerning the first model of capital accumulation, as understood as the process by which capitalists expand their wealth via constantly reinvesting a proportion of their profits back into the production process in order to make greater profits and thereby increase their overall wealth, Marx (1990: 763) claims on the assumption that the composition of capital ‘remains constant’, i.e., that ‘a definite mass of the means of production continues to need the same mass of labour-power to set it in motion’, that ‘the demand for labour’ and the subsequent ‘fund for the subsistence of workers’ will both consequently ‘increase in the same proportion as the capital’ itself and do so ‘with the same rapidity’. In other words, as the composition of capital

grows in terms of a constant ratio of one-part means of means of production to one-part labour power (i.e., a ratio of 1:1) then there will always be a constant increase in the amount of labour-power used by capitalists in the production process (the purpose of which is to produce commodities for sale in the market) which is equivalent to the increase in the amount of means of production also used by capitalists in the production process.

The upshot of all this, as far as this first model of accumulation is concerned, is that as capital grows in a constantly expanding way, i.e., more capitalist profits and therefore more capitalist wealth is being repeatedly generated, so will the capitalist's demand for a constant supply of labour-power from the available working population, since under this model of accumulation this is the way growth in capital occurs. Thus there will always be a constant increase in that part of the composition of capital (its variable constituent) which is invested in labour-power.

However, as Marx claims, there is a natural limit to how much labour-power can be readily supplied by the available working population. Nevertheless, for Marx (1990: 763), it is under these specific economic conditions that the demand of capitalists for a constant supply of labour-power from the available working population results in 'a rise in wages'. This is because, if capitalists do not have access to enough labour-power, which is needed to operate the means of production to produce commodities for sale in the market, then there will be a reduction in the growth of their capital, which in turn translates into a reduction in their profits and wealth. Thus capitalists are forced to pay higher wages to the owners of labour-power (wage-workers) in order for their capital to grow continually.

So, for Marx (1990: 763 and 769), under this model of capital accumulation, the growth of capital affects the lot or fate of the working class in a fairly positive way, since wage-workers are paid a higher wage which in turn allows them to 'support and multiply themselves' and 'extend the circle of their enjoyments … etc., and lay by a small reserve fund of money'. Hence, for Marx (1990: 768-9), under these particular economic arrangements in which the demand for labour-power by capitalists is greater than the supply of it by the available working population (wage-workers), the lot or fate of the working class is on the whole relatively good compared to what it would be like if they were paid lower than subsistence wages or were simply unemployed and destitute.

Despite these 'more or less favourable circumstances' of the working class under this model of capital accumulation, Marx (1990: 763) claims that these circumstances do not in any way

‘alter the fundamental character of capitalist production’. This is principally because, for Marx (1990: 763), as ‘simple reproduction constantly reproduces the capital-relation itself, i.e. the presence of capitalists on the one side, and wage-labourers on the other side’, so does ‘reproduction on an expanded scale, i.e. accumulation, reproduce the capital-relation on an expanded scale, with more capitalists, or bigger capitalists, at one pole, and more wage-labourers at the other pole’. Regardless of how much the lot or fate of the working class is improved under this model of accumulation, it does not for Marx (1990: 770) extinguish this particular social power relation of capitalists and wage-workers which constitutes the underlying social structure of capitalism or ‘threaten the [capitalist] system itself’. At best, all it does for Marx (1990: 769) is ‘loosen’ the ‘golden chain’ which binds wage-workers to capitalists in the production process. Wage-workers will still have to provide, as Marx (1990: 769) claims, ‘a certain quantity of unpaid [surplus] labour’. Which is to say, they will still be exploited by capitalists since surplus labour is still being extorted out of them in the form of surplus-value. Therefore, as much as capitalists must demand a constant supply of labour-power from the available working population in order for their wealth to grow on a constantly expanded scale (hence capital accumulation), so must wage-workers continually sell their labour-power to capitalists in exchange for ‘rising wages’ if they are to reproduce themselves economically, too.

Although, as just shown under this model of capital accumulation, the growth of capital necessitates the growth of the variable component of capital (labour-power), and does so in a way which is as Marx (1990: 768) points out ‘most favourable to the workers’, it is not the point of the capitalist’s drive to accumulate capital that it results in such a favourable economic outcome for wage-workers. As Marx claims, the point for capitalists is to accumulate as much capital as possible as the result of incorporating labour-power into the production process by making wage-workers use the means of production in order to produce commodities for sale in the market, with the aim of making a profit (the basis of their wealth), not to increase the wages of wage-workers and consequently improve their lot in life.

Consequently, for Marx (1990: 770), this process of capital accumulation can lead to two alternate outcomes because of an increase in the wages of wage-workers (i.e., a rise in ‘the price of labour’): it can lead to either (1) a constant rise in the ‘price of labour’ (i.e., a constant increase in the wages of wage-workers) because ‘it does not interfere with the progress of accumulation’, or (2) a decrease in accumulation because a constant rise in the ‘price of labour’

interferes with its progress. If it is the former, then capital accumulation (the expanding wealth of capitalists) will still increase along with the growth of the investment in labour-power (the variable constituent of capital) but not, as Marx (1990: 770) claims, in any 'remarkable' way; and if it is the latter, it will 'slacken' off but at a rate which does not lessen the investment in labour-power (there will still be a demand for it but at a diminished wage-rate). The upshot of these two alternate outcomes is that, as Marx claims, in both cases there will still remain a constant ratio of one to one between the investment in the constant and variable constituents of the composition of capital. Either way, the accumulation process of capital is not developing in any great or 'remarkable' leaps which would reflect the growth of immense capitalist wealth, which is for Marx the ultimate goal of capitalists.

So, what has been identified here by Marx in this model of capital accumulation? It is that there are no changes in the technical-composition of capital which is consequently mirrored by its value-composition. In particular, there are no changes in the ratio between the investment in the variable constituent of the composition of capital (labour-power) and its constant constituent (means of production). However, as I shall now show, when Marx turns to his second model of capital accumulation, there are changes in the technical-composition of capital which is consequently mirrored by its value-composition. Specifically, there are changes in the ratio between the investment in the variable constituent of the composition of capital (labour-power) and its constant constituent (means of production). And because there are such changes in the composition of capital, capital accumulation takes on a new form – an exponential form in which capital or the wealth of capitalists grows rapidly at the expense of wage-workers. Under this model or actual process of capital accumulation, the lot or fate of the working class grows relatively worse compare to the lot or fate of the capitalist class which grows immensely better. It is consequently here, under this model of capital accumulation, that Marx (1990: 781) shows how (1) capitalism constantly produces 'a relative surplus population or industrial reserve army' of unemployed wage labourers and that (2) unemployment is consequently a necessary structural feature of the capitalist economic system itself in that the latter cannot be what it is and develop in the way it does without it.

Marx (1990: 772) claims that once 'the basis of the capitalist system' is given, i.e., its underlying social structure in terms of the social power relation of capitalists and wage-workers is firmly in place, then 'a point is reached in the course of accumulation at which the development of the productivity of labour becomes the most powerful lever of accumulation'.

The subsequent development of and/or increase in the labour productivity of wage-workers within the capitalist production process occurs for Marx (1990: 773) when they are able to produce with 'greater intensity' via the use of 'the means of production' a greater quantity of 'products' of labour 'during a given time'. If, for example, a wage-worker was initially using the old means of production of *A* in order to produce a product of just 10 units per hour and then, with the aid of the new means of production of *B*, a product of 20 units per hour, then comparatively speaking their labour productivity has increased because of the newer means of production.

For Marx, when this happens, i.e., a development in the labour productivity of wage-workers, there is a growth in the amount or mass of the means of production used in the capitalist production process while there is a diminishment in the amount or mass of labour-power used within it at the same time. This simultaneously means for Marx (1990: 773) there is such a change in the technical-composition of capital which is in turn mirrored by its value-composition, as illustrated via the following numerical example: if there was 'originally 50 per cent of capital laid out in means of production, and 50 per cent in labour-power', then, 'later on, with the development of the productivity of labour, 80 percent may be laid out in means of production, 20 per cent in labour-power and so on'. Thus, as the labour productivity of wage-workers within the capitalist production process progressively increases there will consequently be constant changes in the technical-composition of capital as mirrored by its value-composition, albeit, in an inverse way – the value of constant capital (means of production) goes up as the value of the variable capital goes down (labour-power).

While for Marx the development of the labour productivity of wage-workers in the capitalist production process is crucial to the exponential advancement of capital accumulation, it is nevertheless something which progressively occurs under competitive market conditions between different capitalists (whether they be the owners of small or large businesses and/or small or large businesses owned by a group of individual capitalists). Since this is the case, Marx thus claims that there are two types of capital accumulation which enable the progressive development of labour productivity, which in turn is the 'lever' for increasing the wealth of capitalists in an exponential way: *concentration of capital* and *centralisation of capital*.

Concentration of capital simply refers to the process in which the wealth generated via the process of capital accumulation tends to *expand* in the hands of many capitalists instead of wage-workers. While centralisation of capital refers to the process of capital accumulation in

which the wealth generated tends to *expand* in the hands of fewer and fewer capitalists. In both cases labour productivity plays a key role.

In the case of the concentration of capital, what all individual capitalists are endeavoring to do is reduce the amount of labour-power needed to use the means of production so as to produce commodities for sale in the market with the aim or hope of making profits, which is the basis of their potential constantly expanding wealth. To do this, they must be able to increase the labour productivity of the labour-power component of their capital which is used to work the means of production component of their capital. To do this, however, they must constantly introduce a new set of means of production (machines, etc.) which will in turn enable wage-workers to increase the intensity of how much they produce in a certain period (e.g., products of 10, 20, 30 units per hour, and so on). In doing so, there will be a change in the technical-composition of capital which is mirrored by its value-composition. Thus, as labour productivity develops (increases), the value of the constant part of capital (means of production) will go up as the value of the variable part of capital (labour power) goes down. Equally, as this happens, the amount or mass of the means of production used in the capitalist production process will also go up as the amount or mass of the labour-power used to work with it will go relatively down. The fundamental goal of all capitalists who are trying to concentrate wealth in their own hands rather than in the hands of wage-workers, is to extract the greatest amount of 'unpaid, surplus labour' out of wage-workers at the point of production, since as Marx claims this is the true source of their profits and therefore their wealth. In short, it is the aim of every capitalist to exploit their wage-workers as much as possible.

With the centralisation of capital, this process of trying to increase the labour productivity of wage-workers within the capitalist production process also applies. However, here there are some significant differences from the concentration process of capital accumulation. First, centralisation of capital presupposes there is to begin with a concentration of accumulated capital amongst many 'individual capitalists' (Marx 1990: 776). Second, while the concentration of capital accumulation occurs within a competitive market, with all individual capitalists trying to accumulate as much wealth for themselves as possible, the end result of this is that it tends to lead to a centralisation of capital accumulation. This is largely because while through competition individual capitalists may 'repulse' one another they nevertheless 'attract' each other at the same time and thus centralise into fewer but larger capitalists (Marx 1990: 777). As a result of this competitive outcome, the centralisation of capital enables these

types of capitalists to accumulate even greater profits and therefore wealth (accumulated capital). Yet, the outcome of this for labour productivity is that such capitalists who have managed to centralise capital in their hands is that it enables them to increase the labour productivity of wage-workers within the capitalist production process by an even greater intensity because they have greater means of production by which to do so. This consequently means that there is an even greater change in the technical-composition of capital which is mirrored by its value-composition. Thus, as Marx (1990: 779) claims, the process of capital accumulation, which is the process of reproducing the wealth of capitalists on a constantly expanded scale, reaches its zenith under the centralisation process of capital accumulation 'as it supplements the work of accumulation by enabling industrial capitalists to extend the scale of their operations'.

We have now reached a critical point in Marx's account of how the growth of capital affects the lot or fate of the working class. Labour productivity is for Marx (1990: 780) the crucial lever (mechanism) by which the centralisation of capital 'intensifies and accelerates' the accumulation of capital in an exponential way and in so doing 'extends and speeds up those revolutions in the technical-composition of capital which' in turn 'raise its constant portion at the expense of its variable portion'. It is thus the means by which, as Marx (1990: 780) claims, 'the relative demand for labour' diminishes. So, what does this imply for the lot or fate of the working class?

Essentially, it means that as capitalists centralise their capital via the accumulation process, which is the process of reproducing capitalist wealth on a constantly extended scale into fewer capitalist hands, there is a diminished demand for a constant supply of labour-power from the available working population. Specifically, under these very capitalist conditions of capital accumulation, less labour-power is required to work or run the means of production in order to produce commodities for sale in the market in an effort to generate greater profits. This is because labour productivity can be increased in terms of its intensity via the implementation of a greater mass or amount of means of production which are constantly being updated or 'revolutionised' through technological innovations (such as bigger and better machines within the factory or better production-line techniques). The upshot of this diminished demand for labour is that less wage-workers from the available working population will be able to sell their labour-power to such capitalists in the market in exchange for a 'living wage'. As a result, such

wage-workers will be ‘out of a job’ or unemployed. So, the answer to the above question is that there will be unemployment amongst portions of the working class.

Significantly, for Marx, this is not an accidental result and/or feature of the centralisation process of capital accumulation. As Marx (1990: 782) claims:

> capitalist accumulation [is itself a process which] constantly produces, and produces indeed in direct relation to its own energy and extent, a relatively redundant working population, i.e. a population which is superfluous to capital’s average requirements for its own valorization [increments in its own value], and is therefore a surplus population.

As long as capitalists are always striving to reproduce their wealth (and profits) on a constantly expanded scale by intensifying the labour productivity of wage-workers via an increase in the mass of the means of production used in the production process and a decrease in the mass of labour-power used to work or run the means of production, then such a capitalist process of production and accumulation will always produce a relative surplus-population of redundant wage-workers. It is, in short, a necessary and unavoidable outcome of the capitalist centralisation process of accumulation: it is something which cannot but regularly happen under capitalism.

It is notable that while the intensification of the labour productivity of wage-workers plays a necessary and important role as the lever (mechanism) by which capitalists accumulate capital, it is for Marx (1990: 783) nevertheless ‘the means’ through which wage-workers make themselves ‘relatively superfluous’ too. This is largely because as wage-workers become more productive (their labour productivity intensifies) within the capitalist production process, they consequently contribute to a reduction in the amount of labour-power required to work or use the means of production. Hence wage-workers also play a role in creating the conditions for their own redundancy as employed workers.

Consequently, as Marx (1990: 784) has shown, ‘a surplus population of workers is a necessary product of accumulation or of the development of wealth on a capitalist basis’. It is, to be exact, a necessary product of a capitalist accumulation process which is oriented towards centralisation of capital within a competitive market setting. This conversely means that if the capitalist process of accumulation takes the form of capital accumulation as depicted in the first model of it, then there will not be any formation of a surplus population of unemployed

wage-workers. This is principally because there is no mechanism for enabling an intensification of the labour productivity of wage-workers within the capitalist production process which would produce a relative surplus population of wage-workers.

Although for Marx (1990: 784) the capitalist process of accumulation necessarily produces a relatively redundant, surplus population of wage-workers, this relatively redundant, surplus population of wage-workers 'also becomes, conversely, the lever of capitalist accumulation' itself. Indeed, as Marx (1990: 784) claims, 'it becomes a condition for the existence of the capitalist mode of production' itself.

This relatively redundant, surplus population of wage-workers becomes a lever or mechanism of the capitalist process of capital accumulation by turning into what Marx (1990: 784) calls 'a disposable industrial reserve army' of wage-workers. It does this by becoming, as Shaikh (2016: 660) claims, 'a persistent pool of … unemployed workers' which can be drawn on and dispose of in accordance with the interests of capitalists who seek to increase their wealth on a constantly expanded scale. It thus creates, as Marx (1990: 784) claims, 'a mass of human material always ready for exploitation by capital in the interests of capital's own changing valorization requirements', and it does so independently of any 'limits' to 'actual increases in' the size of the 'population'.

Firstly, as Marx (1990: 785) points out, as capitalists accumulate more and more capital because of increases in the labour productivity of the labour-power component of their capital as a result of technological improvements in the means of production component of their capital (hence changes in the technical-composition of their capital), capitalists, especially those who are oriented towards centralisation, are thus in a position to expand their business operations into different branches of production and consequently different markets ('such as railways, etc.'). However, for this to happen, they must have at their immediate availability 'great masses' of wage-workers to draw on in the market. Accordingly, as Marx (1990: 785) claims, the relatively redundant, surplus population of wage-workers supplies such 'masses' for capitalists since such unemployed wage-workers are always looking for the opportunity to work in exchange for wages. Thus, from the perspective of capitalists who are intent on increasing their wealth (capital) on a constantly expanded scale (hence capital accumulation), an industrial reserve army of unemployed wage-workers must be continuously available to meet the needs of such capitalists. As a result, such newly employed wage-workers will play their part in the capital accumulation process of capitalists by adding to the overall labour

productivity, which is the basis for generating greater growth of the capital (wealth) of capitalists. If such an industrial reserve army of unemployed wage-workers is not available in the market, however, then clearly the capitalist's goal of endless capital accumulation will be hindered as a result.

Of course, when capitalists no longer need to draw on this industrial reserve army of unemployed wage-workers, they will consequently dispose of those and any other wage-workers that they have employed. As a consequence, they will all be thrown back into the ranks of the industrial reserve army of unemployed wage-workers by the capitalist, until the next moment arises to re-employ them, and so on. Thus, as Marx (1990: 785) points out, the size of the industrial reserve army of unemployed wage-workers will go up and down relative to 'the varying phases of the industrial cycle' of capitalism.

As Marx claims, an industrial reserve army of unemployed wage-workers cannot have its source in the actual increases of the working population, as there are 'limits' to how much of a relatively redundant, surplus population of wage-workers it can produce. To bear this important point out, Marx (via the thoughts of the nineteenth century political economist, H. Merivale) simply notes that emigration of wage-workers for instance is one crucial way of putting limits on how much and/or how reliable actual increases in the working population will necessarily result in providing an ever available relatively redundant, surplus population of wage-workers to meet the needs of capitalists in the pursuit of expanding their capital (wealth). So, if enough wage-workers emigrate from one region of the world to another, thereby depleting the 'reserves' of the industrial army of unemployed wage-workers to a very low if not zero level, then there will not simply be enough wage-workers for capitalists to draw on whenever there is an opportunity in the market to expand their capital (wealth). So, to avoid such a negative outcome or possibility, capitalists must be able to draw on a permanent pool of unemployed wage-workers – i.e., an industrial reserve army of unemployed wage-workers. Thus capitalists must, through the capitalist process of production, which is founded on the social power relation of capitalists and wage-workers (the fundamental exploitative and oppressive class relation of the capitalist mode of production), be able to constantly produce a relatively redundant surplus population of unemployed wage-workers which in turn functions as an industrial reserve army for capitalists to draw on at their convenience.

This is why Marx (1990: 787) rejects, for example, Malthus's theory of population which holds that while 'a surplus population' of redundant wage-workers 'is a necessity' of modern

capitalist industry it is somehow the result of an 'excessive growth of population'. Marx rejects this theory of Malthus's because Malthus wrongly holds that it is overpopulation which determines the creation of a relatively redundant surplus population of unemployed wage-workers which in turn functions as an industrial reserve army in capitalism, when in fact it is determined by the social power relation of capitalists and wage-workers. For Marx, Malthus's account of what produces a necessary and permanent pool of unemployed wage-workers is wrong because *he ignores* (just as modern orthodox neoclassical economics does, although for different reasons) *the underlying social structure of capitalism*.

As Marx (1990: 788) claims in response to Malthus's theory of population: 'Capitalist production can no longer content itself with the quantity of disposable labour-power which the natural increase of population yields', since it is always contingent on there not being anything like emigration, for example. It thus 'requires for its unrestricted activity an industrial reserve army which is', as Marx (1990: 788) claims, 'independent of these natural limits'.

Apart from these matters, Marx's other major point about how an industrial reserve army of unemployed wage-workers is the very lever or mechanism of capitalist accumulation is borne out in how it ensures that the labour productivity of the labour-power aspect of the composition of capital is intensified. Marx (1990: 789) claims that those wage-workers who are employed by capitalists within the capitalist production process are forced by the presence or existence of the industrial reserve army of unemployed wage-workers to engage in 'over-work'. This is because, for Marx (1990: 789), the 'employed workers' feel the 'pressure' to work harder as a result of the 'competition' amongst the 'reserve' part of the workforce. Nevertheless, at the same time, the 'over-work of the employed part of the working class swells the ranks of its reserve' (Marx 1990: 789). As a consequence, it 'accelerates at the same time the production of the industrial reserve army on a scale corresponding with the progress of social [i.e., the capital process of capital] accumulation' (Marx 1990: 789-90). This in turn becomes a self-perpetuating cycle under capitalism because of the drive of capitalists to accumulate capital (wealth) on a constantly extended scale.

Thus the *dual function* of the industrial reserve army of unemployed wage-workers within the capitalist mode of production is that it not only provides a permanent or persistent pool of unemployed wage-workers upon which capitalists can draw whenever they need to employ greater amounts of labour-power in the production process (as well as dispensing with superfluous workers when they are no longer needed), but it also ensures that those wage-

workers who have employment (for a period of time) engage in over-work (i.e., work with greater intensity).

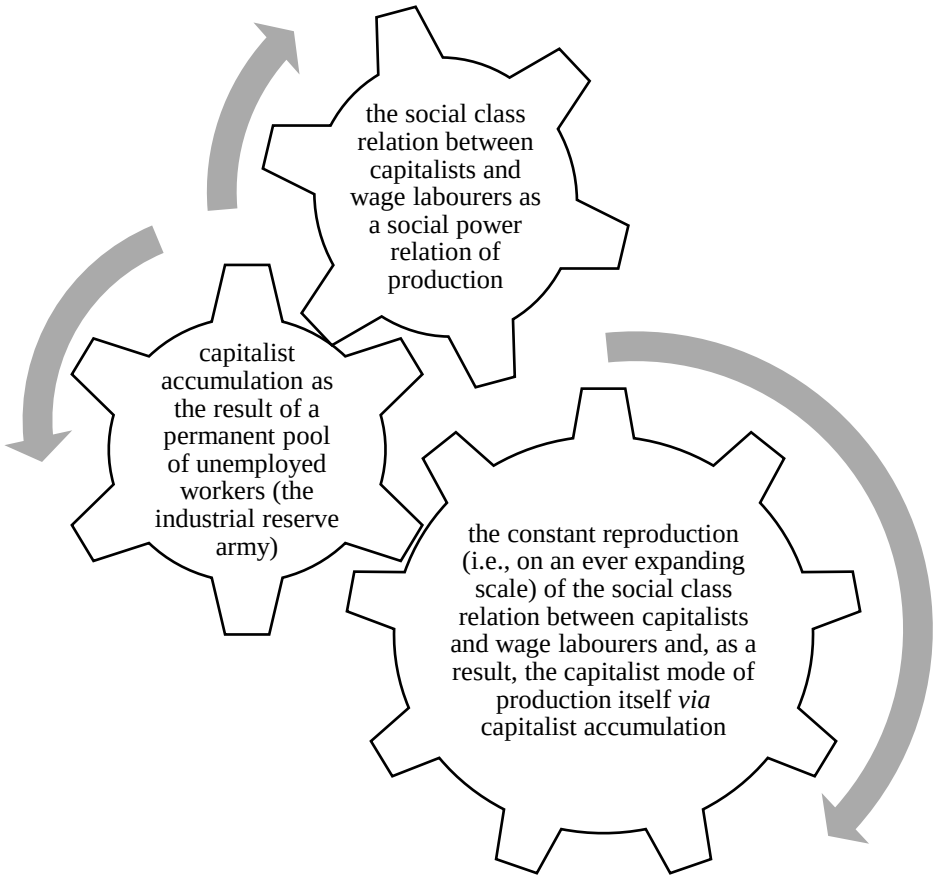
It is at this point that we can consequently draw the connection between the capacity of the capitalist (or the capitalist class as a whole) to exploit the wage-worker (or the working class as a whole) in the sphere of the capitalist production process and the industrial reserve army of labour. Capitalists can exploit wage-workers because the industrial reserve army of unemployed wage-workers is the 'disciplinary stick' by which to threaten the employed part of the working class with. If the employed part of the working class is not prepared to do as they are told by capitalists or their managers and work as hard as they possibly can in terms of labour productivity, then they will be threatened with being sacked. Indeed, the employed part of the working class does not even need to be told this directly as it is patently clear what will happen if they fail to work as required by capitalists or their managers. As Marx (1990: 792) says:

> The industrial reserve army, during the periods of stagnation and average prosperity, weighs down the active army of workers; during the periods of over-production … it puts a curb on their pretensions. The relative surplus population is therefore the background against which the law of demand and supply of labour does its work. It confines the field of action of this law to the limits absolutely convenient to capital's drive to exploit and dominate the workers.

From this, it is clear that a surplus population or industrial reserve army of unemployed wage-workers is a necessary structural component of the capitalist mode of production, since without it, capitalists will not be able to reproduce their wealth (capital) on a constantly extended scale, which in turn means that the capitalist economic system will also not be able to reproduce itself on a constantly expanded scale. This consequently means, as Marx has shown, that capitalism must be capable of constantly producing and maintaining a permanent pool of unemployed wage-workers. Of course, for this to happen, then the underlying social structure of capitalism – the social power relation of capitalists and wage-workers (which is in fact a class relation) – must first be firmly in place, as Marx claims. For it is on this core foundational basis that the whole capitalist economic system rests.

The following graphic depicts what can be called Marx's causal cog or causal mechanism model of how the capitalist mode of production constantly reproduces itself on an ever-

expanding scale via the cog or mechanism of the industrial reserve army of unemployed wage-workers:

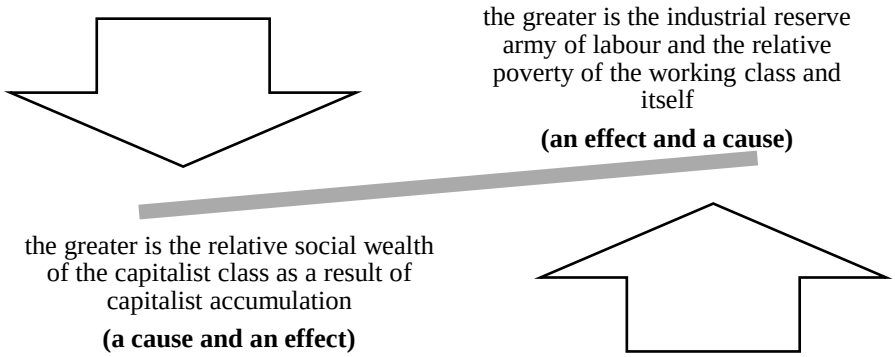


So, the industrial reserve army of unemployed wage-workers is the causal cog or causal mechanism which drives the whole capitalist economic system: without it, the capitalist mode of production cannot be constantly reproduced on an ever-expanding scale and nor can the capital/wage-labour relation be constantly reproduced. But, for this to happen, the capital/wage-labour relation must also be in place. It is not a chicken or egg situation – so which comes first? Although Marx does show, in his chapter on 'primitive' or 'original' accumulation (i.e., Chapter 26 of Volume 1 of *Capital*), that of course the capital/wage-labour relation had to come first, historically speaking. The theoretical point to grasp here is how they all operate together. So, what can be said here about this causal nexus is that (1) the capital/wage-labour relation is the underlying bedrock of the capitalist system (it is what essentially distinguishes capitalism from other economic systems or modes of production); however, (2) for this social relation of production to be maintained and developed, the ongoing existence of an industrial reserve army of unemployed wage-workers is central to it.

It is consequently Marx's (1990: 798) conclusion that:

> The greater the social wealth … the greater is the industrial reserve army… But the greater this reserve army in proportion to the active labour-army, the greater is the … surplus population … The more extensive … the pauperized sections of the working class and the industrial reserve army, the greater is official pauperism.

For Marx (1990: 798), this statement expresses '*the absolute general law of capitalist accumulation*'. It thus can be graphically represented as:



This, then, is *the economic law of motion* of the capitalist mode of production which Marx has sought to reveal in his scientific analysis of it via the Galilean method of abstraction and idealisation, or, the method of successive approximation.[1] As a mutual or reciprocal causal relation – in which the relative social wealth of capitalists causes the industrial reserve army, while the industrial reserve army causes the relative wealth of capitalists to be maintained or increased – it expresses the central developmental tendency of the capitalist mode of production. It is consequently on this basis that the capitalist mode of production constantly reproduces itself on a progressively increasing scale. In doing so, it constantly perpetuates the widening gap between the relative wealth of the capitalist class and the relative poverty of the working class and the industrial reserve army of unemployed wage-workers. This is, for Marx, a necessary outcome of the capitalist mode of production. Without it, the capitalist mode of

[1] While Marx takes this to be the central economic law of motion of the capitalist mode of production in Volume 1 of *Capital*, it is not as Mandel (in Marx 1990) notes the only economic law of motion that Marx reveals about the capitalist economic system. Increasing concentration and centralisation of capital, the increasing organic composition of capital, the tendencies to crises in capitalism, etc. are also some of its other economic laws of motion that Marx reveals in the three volumes of *Capital*.

production will not constantly reproduce itself on a progressively increasing scale. It is thus a necessary feature of the system itself; it is a necessary part of how it operates and develops.

5.5 Marx's joint projects in his critique of political economy in Volume 1 of *Capital*: his theoretical and methodological projects

In this account of Marx's critique of political economy in Volume 1 of *Capital,* I have shown how Marx's theoretical aim of revealing the economic law of motion of the capitalist mode of production is underpinned by his methodological approach of seeking to uncover the underlying essence of phenomena hidden behind their appearances. In doing so, I have shown how Marx seeks to emulate the scientific approach and achievements of Newton concerning his scientific account of the solar system. What we have seen Marx do – like Newton has done *and* recommended by Hegel to do – is go beyond immediate experience (appearances) to acquire some theoretical knowledge of how things really are (essences). This is, to all intents and purposes, a *scientific realist* project as spelt out in the tradition in the philosophy of science which comes out of Locke's empiricism – i.e., the tradition which holds that science not only aims to uncover the hidden causal structure (Locke's real essences *and* Marx's essences) which in turn gives rise to the observable phenomena of the world (Locke's nominal essences *and* Marx's appearances), but that science is sometimes successful in doing this.

5.6 Conclusion: the essence of the capitalist mode of production as the causal foundations of its appearances

Marx, in revealing the essence of the capitalist mode of production – in terms of uncovering its economic law of motion – has revealed that its appearances – the way it appears on the surface of society as 'an immense collection of commodities' – is causally founded on this specific basis. Consequently, given Marx's Hegelian conception of essence and appearance, these appearances of the capitalist mode of production are its necessary appearances, as Lebowitz (2009) says. This is how any society which is based on the capitalist mode of production and which operates in terms of its specific economic law of motion will immediately and necessarily appear on the surface to both its participants and the theoreticians who seek an understanding of it. Thus, for Marx, there is a necessary causal connection between the way a capitalist society appears on its surface and how it essentially is beneath its surface. If you alter the underlying essence of the system you will consequently get a different set of appearances; and conversely, if you have a different set of appearances, you will consequently have a

different underlying essence. Either way, you will have a type of society which is not based on the capitalist mode of production. This is both a very Hegelian and Lockean point about the causal relation between essence/real essence and appearance/nominal essence. The two are causally connected to each other; you cannot have one without the other.

6

Marx's critics and other issues

6.0 Introduction

We now consider some major criticisms made of Marx's critique of political economy as a supposed work of science based on his distinction between appearance and essence, as well as some other issues relating to it. As I shall show, Marx's critique of political economy is defensible given his methodological and theoretical aims.

6.1 Marx's critics

6.1.1 Elster's claim that Marx misinterprets Hegel's essence and appearance conception

I start with Elster's claim that Marx misinterprets 'Hegel's theory of essence and appearance' (1987: 125). First, Elster offers two different interpretations of what the term 'appearance' may be contrasted with. In taking the term 'appearance' to mean 'that which appears', Elster says it can be contrasted with two types of 'antonyms' (1987: 124). On the one hand, it can be contrasted with 'what is hidden and accessible only by the mediation of thought' (Elster 1987: 124), i.e., the hidden essence of phenomena – like, for example, the atomic structure which is the essence hidden behind the appearances of a table. While, on the other, 'since what appears' to any person 'always appears to a person occupying a particular standpoint and observing the phenomena from a particular perspective', then it can be contrasted with 'the *global network* of appearances that is not tied to any particular standpoint' (Elster 1987: 125). Accordingly, for Elster (1987: 125), it is the second interpretation which 'correctly' represents Hegel's theory of essence and appearance, as it 'says that the essence is *the totality of interrelated appearances*, not something that is "behind" them and of a different ontological order'.

Now Elster claims that Marx conceives the relation between appearance and essence along the lines of the first interpretation rather than the second one. His (1987: 125) evidence for this is 'how Marx conceived of the relation between labour values and prices', i.e., 'labour values' are conceived as the hidden essence 'behind' the appearances of 'prices'. Consequently, for Elster, Marx maintains the incorrect interpretation of Hegel's theory of essence and appearance

and, therefore, misinterprets Hegel. The upshot of this is that Marx's account of 'labour values' and 'prices' is built on 'a faulty understanding of Hegel' (Elster 1987: 125). So, for Elster, despite the fact (as far as he is concerned) that Marx's account of the relation between 'labour value' and 'prices' is incorrect, it is not helped by his misinterpretation of Hegel's theory of essence and appearance.

Elster (1987: 125) does concede, however, that there are places in Marx's economic theory in all three volumes of *Capital* where it could be said that he employs a roughly correct understanding of Hegel's theory of essence and appearance, as with his references to 'the blinding effects of competition', his analysis of wages, his distinction between labour-power and labour, and his account of fetishism. But overall, for Elster, Marx has got Hegel wrong in his use of a distinction between appearance and essence.

What are we to make of all this? I think the first thing to say here is this: Elster's main evidence for claiming that Marx uses a 'faulty' conception of Hegel's theory of essence and appearance is Marx's account of the relation between 'labour values' and 'prices'. Now, for sure, Marx does conceive the relation between the two in terms of essence and appearance as, for example, Shaikh (1977, 1981, 1982 and 1984), Smith (1990 and 1993), Hunt (1993), Arthur (2004), Dussel (2001) and Moseley (2016) have all shown and defended, but this is not the main point of Marx's distinction between appearance and essence in his critique of political economy in Volume 1 of *Capital*. Marx is not out to develop a theory of relative prices, or some such thing. As we have seen, Marx formulates his distinction between appearance and essence based on Hegel's conception of essence and appearance, which as I have shown is a conception between the causal depth-element of phenomena and their manifested surface-element and the two elements are interconnected to each other. The basis of this conception is the middle part of Hegel's *Logic*, the "Doctrine of Essence", rather than any other part, such as the "Doctrine of Notion" – which, as Elder (1981: xviii-xx and Ch. 3) explains, is about how Hegel's concept of "The Idea" ties together everything not from the standpoint of the 'Understanding' but seeing the purpose revealed by the interconnection of all things, including the relations grasped incompletely by the 'Understanding'. It is probably this part of Hegel's *Logic* that Elster has in mind when criticisng Marx. Anyway, as I have also shown, Hegel's conception is very Lockean too. Like Locke's own distinction between real and nominal essences, Hegel also conceives essence and appearance as both an ontological and causal relation. Marx, as I have shown, subsequently appropriates Hegel's essence and appearance conception for his own purposes in Volume I of *Capital*. Firstly, it allows him to treat the sphere of simple circulation

and exchange, and the sphere of production and accumulation as, respectively, representing a distinction between the appearance and essence levels of the capitalist mode of production. In that sense, it is certainly an ontological distinction. Also, Hegel's essence and appearance conception allows Marx to conceive the central aim of science as the task of uncovering the essence of phenomena which lies hidden behind their appearances, which is in keeping with the central scientific aims of Newton in the *Principia*. This is the scientific aim of Marx's methodological project in Volume 1 of *Capital*. Now Elster, in his criticisms of Marx's so-called 'faulty understanding' of Hegel's theory of essence and appearance simply overlooks these very important points about how Marx appropriates Hegel's essence and appearance conception for his own methodological use in his critique of political economy in Volume 1 of *Capital*. He does this because he is too narrowly focused on whether Marx's account of the relation between 'labour values' and their 'prices' rests on a faulty methodological basis, rather than looking at Marx's distinction between appearance and essence in terms of his overall methodological project in his critique of political economy in Volume 1 of *Capital*. And since he fails to do this, he then also fails to see how this methodological project is connected to Marx's theoretical project of attempting to reveal the economic law of motion of the capitalist mode of production.

The conclusion to draw here, then, is this: it is not that Marx actually misinterprets Hegel's conception of essence and appearance; rather, it is that Marx appropriates a certain conception of it for his own methodological and theoretical purposes, which he derives from the "Doctrine of Essence" part of Hegel's *Logic*. Elster may well be quite right in what he says, but that is all predicated on whether Marx is actually operating with that particular theory of essence and appearance which seems to originate in the "Doctrine of Notion" part of Hegel's *Logic*. But, as I have explained, that is not the case. Therefore, we need not accept Elster's criticisms of Marx's Hegelian-cum-Lockean conception of appearance and essence.

6.1.2 Wolff's criticisms of Marx's distinction between appearance and essence, and his own (preferred) distinction between appearance and reality

I shall now consider some criticisms of Wolff's (1988) about Marx's distinction between appearance and essence being a form of essentialism and how it should be reformulated as a distinction between appearance and reality.

First, Wolff (1988: 35) accepts the following interpretation of Marx's distinction between appearance and essence, which for him has its roots in criticisms of the alleged underlying

'essentialism' of the 'Socratic distinction between appearance and reality'. An illustration of this Socratic distinction is given by how a stick appears bent in a dense medium (like water) as opposed to how it normally looks straight when it is not in such a medium. The anti-essentialist criticism of this Socratic distinction between appearance and reality goes like this:

> To call the straightness of the stick the *reality* and my perception of it as bent an *appearance* is to presuppose that there is an objective ground for the claim that the straightness is an essential property of the stick and the bentness a mere subjective mode in which that essential property manifests itself.
>
> (Wolff 1988: 35-6)

This anti-essentialist line is then applied to Marx in terms of his economic theory of capitalism and his theory of history:

> The same ontological presupposition, it has been argued, is implicit in the theses that profit, rent, and interest are *appearances* of surplus value, that cultural and political institutions are *appearances* of, or manifestation of, the underlying social relationships, and that the inner essence of history is class struggle.
>
> (Wolff 1988: 36)

Wolff (1988: 36) further reports:

> Such ontological claims, it is said, make philosophical sense only on the fundamentally religious premise that being is the product of a purposeful creation … without such a premise, there is no ground for calling one aspect or element of the world *truly real*, another aspect or element *merely appearances*.

Moreover, Marx, for these anti-essentialists, 'frequently speaks in this essentialist way' (Wolff 1988: 36). Consequently:

> They conclude that insofar as we wish to follow Marx in the development of a scientific theory of society … we must put behind us these last philosophical echoes of religious mythology, and develop a theory of capitalism in which the distinction between essence and appearance plays no role.
>
> (Wolff 1988: 36)

Wolff (1988: 36) thus accepts 'this critique of essentialism' and consequently declares that Marx's theory of capitalism which is based on a distinction between appearance and essence should be abandoned for a theory of capitalism based on 'an objectively grounded distinction between appearance and reality' instead.

Before assessing the merits of Wolff's position, let us first clarify what he means by his own preferred distinction between appearance and reality. Obviously, in one sense, he means it is above all devoid of any religious connotations. But what he wants it to clearly signify, in another sense, is that there are no ontological differences between one aspect of something being somehow more real than another aspect of it, which is what he takes the appearance and essence distinction to be ontologically about. So, when we say for example that a stick is both bent, when in a medium like water, and it is straight when it is in a medium like air, then both phenomena are equally real – although, when you pull a bent looking stick up, the bend moves along the stick, which is impossible if the point of bending in the stick is supposed to be anything but the way it looks to our eyes. Also, what he wants to say is that the distinction between appearance and reality is not a distinction between 'delusion and fact' (Hunt 1993: 185). Let us now assess the merits of Wolff's views here about not only Marx's distinction between appearance and essence but also about his own preferred distinction between appearance and reality.

To do this, though, we need to refer to Marx's critique of political economy in Volume 1 of *Capital* itself, i.e., *to his actual scientific practice and achievements*, rather than to any philosophical speculations about his appearance and essence distinction being based on some alleged 'religious' foundations because of its Hegelian origins. For this is the only template by which we can possibly assess Marx's distinction between appearance and essence.

As already said in the response to Elster's criticisms of Marx distinction between appearance and essence, Marx in the first instance uses his distinction to structure his presentation of the capitalist mode of production in terms of its two distinct but interconnected spheres: the sphere of simple circulation and exchange (the marketplace), and the sphere of production and accumulation (the arena in which wage-workers produce commodities and 'surplus-value' on a progressively increasing scale). Consequently, these two spheres are taken to be representative of two distinct but interconnected levels of the phenomena of the capitalist mode of production: the former is the appearance level whilst the latter is the essence level. From an ontological perspective, Marx does not conceive the appearance level of the capitalist mode of

production to be less real than its essence level. For him, both ontological levels of the capitalist mode of production are as equally real as each other. But they are, as Larrain (1986: 69) points out, the inverse of each other, as evident in this already quoted text of Marx's (1981: 311):

> … *In competition … everything appears upside down.* The finished configuration of the economic relations, as these are visible on the surface, in their actual existence, and therefore also in the notions with which the bearers and agents of these relations seek to gain an understanding of them, is very different from the configuration of their inner core, which is essential but concealed, and the concept corresponding to it. It is in fact the very reverse and antithesis of this.

Marx's distinction between appearance and essence, like Wolff's own distinction between appearance and reality, is therefore *not* a distinction between delusion and fact, as Hunt (1993: 185) points out. Additionally, from an epistemological perspective, Marx's distinction is between, as Hunt (1993: 185-86) further says, the way 'the surface of society presents itself to the passive observer, and what theories … agents use to … represent as the causal foundation of … phenomena' (see also Larrain 1986: 69 and 123-24, fn. 7). So, Marx's distinction is straight forward from both an ontological and epistemological perspective. Indeed, given Wolff's other writings on Marx (1980b and 2013), wherein he construes Marx as using a distinction between appearance and reality, the two distinctions have much in common with each other in terms of their ontological and epistemological aspects.

What about the alleged essentialism of Marx's distinction between appearance and essence? Perhaps the best way to allay Wolff's concerns (if not his anxieties) here, is by reference to Locke's own distinction between real and nominal essences. Clearly, in one sense, Locke could be called an essentialist, but not in the sense which distinguishes his type of 'essentialism' from the essentialism of the Aristotelianism of his times. Locke criticises this type of essentialism because of its claim that there are specific 'Scholastic Forms' in the natural world – essences which never change – which give rise to their respective species of things in the natural world. Now Locke thinks this view of essence is wrong as it denies change in the natural world at both the *real essence* and *nominal essence* level of things. For Locke, while it is supposedly the case that real essences causally determine the nominal essences of things, this does not mean that the real essences of things are permanently fixed, i.e., they are unable to change in their 'internal constitution'. For it is his view that if the internal make-up of any real essence of something changes, then so will its nominal essence. Now, this position of the relation between

real and nominal essence is like Marx's view of the essence of phenomena and their appearances. Marx too holds the view that if the essence of phenomena changes so will their appearances. Specifically, if the essence of any economic society changes in terms of its social structure then so will its appearances, as would be seen if one goes from a capitalist market economy to a socialist market economy.

So, if one wants to call Marx an essentialist, then one needs to be very clear about what type of essentialism it is that Marx supposedly subscribes to. For a start, it will not be the form of essentialism that Locke rightly criticises. It will, at least to some extent, be like Locke's type of 'essentialism' instead. And if that is so, then one has no philosophical warrant to reject Marx's distinction between appearance and essence for being 'essentialist', as Wolff does.

I therefore conclude for all the above reasons, that Wolff's concerns about Marx's distinction between appearance and essence are without any philosophical warrant.

6.1.3 Cohen's criticisms of Marx's conception about the aim of science

I now consider the philosophical criticisms that Cohen (2001) makes about Marx's conception of the aim of science. These criticisms draw on: (1) Marx's distinction between appearance and essence (which Cohen reformulates as a distinction between appearance and reality) and his view about how it is the aim of science to discover the latter; and (2) his 'dictum' about how '[i]f there were no difference between reality and appearance, there would be no need for science' (Cohen 2001: 326). It is Cohen's (2001: 326) aim to show that since Marx's 'dictum entails that … socialism and social science are incompatible', then, 'as socialism develops, social science must wither away'. Consequently, Marx's conception of the aim of science, which is to 'reveal a gulf between reality and appearance' (Cohen 2001: 341), can be abandoned.

To illustrate Marx's distinction between appearance and reality and how it is the aim of science to discover the latter, Cohen does so via some familiar examples of Marx's from the natural sciences. The first one is from the field of chemistry: 'The air we breathe appears to be elementary, but chemistry discloses that it is composed of distinct substances which are not detected by the nose' (Cohen 2001: 327). Another is from astronomy: 'The sun appears to move across the heavens, but science replaces this proposition, which ordinary experience supports, by the thesis that it is the earth which is the moving body' (Cohen 2001: 327). These examples of Marx's, says Cohen (2001: 327), are meant to serve as 'analogues' of how capitalism 'appears to those who live inside it' and how it is scientifically analysed by Marx.

Accordingly, for Cohen (2001: 327), while it may appear to workers in the market that they 'receive the whole value of what they produce' in terms of wages, they are not, however, 'paid for all the labour they have performed', according to Marx's scientific analysis of what occurs in the capitalist production process between capitalists and wage-workers.

From this initial presentation of Marx's distinction between appearance and reality and how it is the aim of science to reveal the latter, Cohen subsequently says that these differences between how things appear to ordinary perception and how things really are according to science are real. If, according to Cohen (2001: 328), we were to correctly perceive things like 'the constitution of air' or 'the movements of heavenly bodies', then our senses would have to be of a different order, such as we would have to have a nose which was capable of detecting through breathing the different components of air, or, if we 'sincerely claimed to perceive a stationary sun and a rotating earth' we would probably be 'suffering from some disorder of vision'. Under these circumstances, there would be no differences between the way things appear (appearance) and how things really are (reality). Since this is not the case, for Cohen (2001: 328), then the way things appear to us is more like 'seeing mirages than having … hallucinations', as they are an objective part of the real world whereas the latter are not (they are subjective and private experiences). Thus, for Cohen, Marx's conception of the difference between appearance and reality is not between having a hallucination and correctly perceiving the real world but more akin to a difference between perceiving a mirage and what gives rise to it.

Considering this, Cohen (2001: 329) takes Marx's conception of the aim of science to be one which seeks to reveal '*a gulf between appearance and reality*' and that it does this '*when and only when the explanation of a state of affairs falsifies the description it is natural to give of it if one lacks the explanation*'. Consequently, science gets its point from there being a gulf between appearance and reality, otherwise there is no need for it.

So, at this stage of his discussion of Marx's distinction between appearance and essence, Cohen (2001: 326) apparently accepts Marx's dictum about '[i]f there were no difference between reality and appearance, there would be no need for science'. This also implies that he apparently accepts Marx's conception of the aim of science, which is to reveal (in Marx's terminology) the essence of phenomena which lies hidden behind their appearances. However, it this very dictum that Cohen wants to reject and in doing so reject Marx's conception of the aim of

science. How does he do this? Cohen does it by contrasting a capitalist society with a socialist society.

In a capitalist society, Cohen argues via Marx's account of it that in such a society there is a gulf between the way things appear on the surface to those who live in it and how things really are according to science. In such a society people do not understand how it works because they only ever perceive the surface appearance of things, like wage-workers believing they are paid for a full day's work or capitalists believing that their profits are what are left over after they paid for all their costs of production. And of course, this lack of scientific understanding of how a capitalist society works is not helped by the phenomenon of fetishism, which, as Cohen (2001: Ch. V and 328-9, 331 and 338) knows, prevents people from understanding the actual social relations of production in which they stand to each other. Thus, as he has outlined in the above account of Marx's methodological views about the aim of science, under such circumstances there is consequently a need for science to reveal a gulf between the way things appear under capitalism and how they really are according to science, so those who live inside it (especially wage-workers who stand to benefit from such a scientific account of capitalism) can better understand such a world, which in turn may be used to help transform such a society into something like socialism. So far, so good - according to Cohen.

Now, what about a socialist society? Does it too, Cohen asks, provide any substantial scientific reasons for why science should be called upon to reveal a gulf between appearance and reality? The short answer, for Cohen, is no. This is largely because, according to Cohen, in such a society there will in fact be no so-called gulf between appearance and reality to be revealed by science. In such a society it will be clear to everyone that, for instance, all work is paid for as the workers of such a society will not only be the owners of the means of production but also in control of how things are both produced and distributed amongst themselves. Also, there will not be any phenomenon of fetishism to prevent the members of such a socialist society from understanding the social relation of production in which they all find themselves. Thus, in such a socialist society, appearance and reality will be one and the same (i.e., they will coincide with one another). Consequently, in such a socialist society, there will be no need for social science and therefore its aim of revealing a gulf between appearance and reality will be methodologically redundant.

This contrast between these two types of society – a capitalist society and a socialist society – thus throws up a philosophical puzzle about Marx's conception of the aim of science and his

dictum about what gives rise to it. In one case, there seems to be a justificatory need for it, while in the other there is none. And yet, as Cohen points out, there will presumably still be a need for 'scientists' of some sort in a socialist society whose 'scientific' role is to study such a socialist society, even though they will no longer have the methodological aim of revealing a gulf between appearance and reality since they are one and the same. Consequently, this contrast between two types of society – a capitalist and a socialist society – leads Cohen to conclude that it cannot always be the case that the central aim of science, as Marx conceives it, is to reveal a gulf between appearance and reality (or, to put it in Marx's terminology, a gulf between appearance and essence). In addition, it cannot always be the case that if there is no gulf between appearance and reality, then there is no need for science. Therefore, as Cohen (2001: 326) concludes, Marx's dictum about what supposedly gives rise to the need for a scientific explanation of the gulf between appearance and reality (or appearance and essence) 'entails that … socialism and social science are incompatible' given that under a socialist society there is no difference between appearance and reality (or appearance and essence). Hence, for Cohen, it logically follows that Marx's conception of the aim of science can be, and ought to be, abandoned if we still want to say that there is 'science' and 'scientists' under a socialist society.

If Cohen is right about this, then this would suggest a major philosophical problem with Marx's own conception of what he takes to be the central scientific aim of his critique of political economy in Volume 1 of *Capital*. It also raises a major problem for my own account of Marx's critique of political economy in Volume 1 of *Capital* as a work of science, based on his distinction between appearance and essence. Is Marx's conception of the central aim of science defensible against Cohen's discussion of it? I think it is.

First, is it true that under socialism there is no discrepancy between appearance and essence? To answer this question, let us briefly consider two versions of socialism: a non-market socialist society as based on the former Soviet Union model of central planning (Lebowitz 2012 and 2015) and a market socialist society as based on the Mondragon experiment in Basque (Schweickart 1996, 2002 and 2011).

In a non-market socialist society, as Lebowitz (2012 and 2015) points out, its principal social relation of production was between the 'vanguard' and the 'workers' (i.e., between the 'vanguard party' of the socialist state [the communist party] and the 'working class'). Under this relation, the vanguard party controlled the state, the means of production were 'the property

of the state' and the state controlled 'the direction of the economy through central planning' (Lebowitz 2015: 94). As a result, the production, distribution and consumption of different bundles of goods were organised and directed by a central planning administrative body of the state in an attempt to produce 'harmonious cooperation' (Lebowitz 2015: 95). Thus, under this arrangement, there were many individual production units ('factories) which were given certain 'quotas' by the central planners to meet. Each of these 'factories' were comprised of 'mangers' and 'workers', and the workers would use the means of production to produce the different bundles of goods under the direction of their managers. Of course, under such a society there were no 'markets' in which goods were exchanged, as they would be in a capitalist market society. The overall aim of such a non-market socialist society was 'growth' or 'development': growth or development in both what was being produced (greater variety and quantities of goods) and how it was being produced (by new techniques of production).

Now, within such a non-market socialist society, all workers were permanently employed and paid a livable wage for their work: they were effectively 'wage-workers'. This meant that, in principle, there was no unemployment or any great inequalities. However, as Lebowitz points out, such a society nevertheless produced in the end 'shortages' in terms of goods and labour (not enough goods were being produced and not enough labour could be drawn on) and a certain type of behaviour amongst its managers (they engaged in bonus-maximising behaviour which led to poor-quality and unwanted goods). How come? Before answering this question, let us just clarify what has been depicted in terms of the appearance and essence of the system.

The appearances of such a non-market socialist society are represented by its 'concrete phenomena', especially by what Lebowitz (2015: 92) calls its 'shortage economy' and the 'apparent behaviour of actors' within it. Its essence, however, is constituted by its vanguard relation of production: a relation in which the vanguard of the state controls the means of production while the workers do not, as they are nothing more than mere wage workers (paid employees of the 'vanguard state'). There is therefore a discrepancy between how things appear on the 'surface' of such a society and how things actually are beneath it.

To answer the above question, then, it is Lebowitz's view that we need to go behind the concrete phenomena of such a non-market socialist society (the 'shortage economy' and 'apparent behaviour of actors' within it) to analyse its actual social relation of production, as it is not immediately apparent on the 'surface' of such a society what is generating its particular 'concrete phenomena'. Thus, for Lebowitz, there is a real need for us to go behind the

appearances of the observable phenomena of such a society in order to analyse its underlying essence.

In doing so, what will be revealed, as Lebowitz (2015: 97) shows, is that while the vanguard relation of such a non-market socialist society constitutes its essence in the sense that the system cannot exist without it, it is the actual interplay between the actions of the managers of various factory enterprises and the aims of the vanguard that produced the observable concrete phenomena in terms of various goods and labour shortages:

> The combination of the behavior of managers attempting to income-maximize in their own enterprises under the constraints of the [central] plan [of the vanguard state] and the efforts of the planners to compel managers to produce as much as possible … produced the particular shortages characteristic of "real socialism' [i.e., the non-market socialist societies of the former Soviet Union].

In considering Cohen's central claim, then, it is not true that Marx's dictum about the central aim of science is invalidated by a lack of a discrepancy between appearance and essence under socialism. This concrete example of a non-market socialist society illustrates that (1) there is a discrepancy between appearance and essence in such a society and that, as a result, (2) there is a real need for science to analyse those relations which lie behind the concrete phenomena of such a society, without which they cannot manifest. Thus, contrary to what Cohen claims, even under a non-market form of socialism, it is still the central aim of science to reveal the essence which lies hidden behind the appearances of the observable phenomena. What about market socialism? Does it support Cohen's central thesis?

In a market socialist society, as Schweickart (1996, 2002 and 2011) points out, its principal social relation of production is that of worker self-management. This essentially means that it is the 'workers' themselves who run their own 'enterprises' by making their own decisions about what to produce, how much to produce and how to divide up the 'profits' of the business amongst its members. These self-managed workers are not wage workers in the sense of being paid employees, as one might find under either capitalism or non-market socialism, since they do not work for others. Also, these worker self-managed enterprises compete with other similar enterprises in the market. Thus these worker self-managed enterprises produce things of use which are then exchanged in the market for money (or a certain price as determined by the forces of demand and supply). In short, they produce 'commodities' (i.e., useful and exchangeable things) for the market. The overall aim of each enterprises is to make 'profits',

which can then be shared amongst its members. In addition, in such a market socialist society, there exist available social funds which can be drawn upon in order to finance or assist any enterprise. These three features thus constitute the main aspects of a market socialist society, as illustrated by the worker cooperatives of Mondragon in the Basque region of Spain.

Admittedly, this is a bare-bones description of such a society. Even so, it is enough to deal with Cohen's charge against Marx's conception of the central aim of science. So, what constitutes the appearances and essence of such a market socialist society?

Firstly, its essence is its principal social relation of production, which is the relation between the self-managed workers of any enterprise. It is a relation in which no-one can dominate any other, as found under capitalist relations of production or vanguard relations of production, which is not to rule out of course any divisions of labour within any particular worker self-managed enterprise (such as between the designers of products and their assemblers). Without this particular social relation of production being in place, there can be no socialist society which operates through markets. Its appearances, however, stand for all the observable phenomena of the market from the bundle of commodities being produced for it through to such things as 'unemployment', etc. (As Schweickart (2011: 75-6 and 102-4) points out, there can be 'unemployment' in a market socialist society, but it need not be a permanent feature given the role of the state as the 'employer-of-last-resort'.)

Now, to just focus on the particular problem of how bundles of commodities are produced for the market (which is at the level of appearances), is it apparent how this all occurs on the 'surface' of a market socialist society? Just like in a capitalist market society, all we can and do observe is how bundles of commodities are bought and sold for a certain price as determined by the forces of demand and supply. What is not apparent is how this is all based on a specific set of social relations of production (which is at the level of essence). There seems therefore to be a discrepancy between the appearances and the essence of such a socialist market society.

Once again, if we are to understand how this all happens (the selling and buying of the different bundles of commodities in the market), then we need to go beyond the appearances of the system to analyse what actually happens at its essence. If we do so, we will then come to see that the various bundles of commodities which are sold and bought in the market are the result of how the members of a worker self-managed enterprise cooperate with each other in order to produce the requisite bundles of commodities within a competitive socialist market economy.

So, even in a socialist market society there is no support for Cohen's claim that Marx's conception of the central aim of science is methodologically redundant. It is just not true that there is no discrepancy between appearance and essence in such a market form of socialism.

It can also be noted that if in a socialist market society there are commodities being produced for the market, then this alone should indicate to Cohen that there is a central epistemological problem which needs dealing with – the problem of the 'fetishism of commodities'. Such a problem, as Geras (1973) says, demands that a 'critical science' be called upon in order to penetrate behind the 'fetishism of commodities' – that market phenomenon which prevents people from understanding the social relations in which they find themselves. Of course, this is not the near impenetrable fetishism of commodities of capitalism that Marx analyses, a problem which required the three volumes of *Capital* to penetrate.

So, overall, we can conclude that Cohen's central thesis about Marx's conception of the main aim of science is not in any way supported by the two concrete forms of socialism: non-market socialism and market socialism. In both cases, there is a discrepancy between appearance and essence and so science is needed in order to explain the causal links between how things appear on the 'surface' of such societies and how they essentially are.

6.1.4 Blaug's claim that Marx has failed to reveal the essence of capitalism

We now turn to the claims of Blaug (2012). Blaug makes two major claims against Marx's overall methodological approach in *Capital*. The first claim is about his so-called 'sleight-of-hand' approach concerning the appearance and essence levels of the capitalist mode of production, whilst the second claim is about Marx reverting to the use of 'epicycles' in Volume 3 of *Capital* to save his theoretical account of the capitalist mode production in Volume 1. The two claims, when brought together, suggest that Marx, despite what he thinks he has done in Volume 1 of *Capital* – revealed the essence of the capitalist mode of production – has not done so. I first present Blaug's claims.

Blaug's first claim against Marx goes like this. First, he (2012: 287) says: 'The ploy that makes Marxian economics so appealing when read uncritically is the ploy of the two-tier argument'. This so-called two-tier argument involves the following steps: 'There is a first floor to the house, the visible world of prices, wage rates and profit rates, and a basement to the house, the invisible world of labour values and surplus value' (Blaug 2012: 287). Accordingly, for Blaug (2012: 287), this implies: 'It is not only that the first floor is visible, while the basement is not; the economic actors that reside on the first floor are ignorant of the nether world of the

basement'. Now, for Blaug (2012: 287), '[t]he subterfuge that Marx perpetrates' here 'is to move the basement to the first floor and the first floor to the second one'. This consequently allows Marx, claims Blaug (2012: 287), to 'subtly suggest … that the first floor is in some sense more real than the second one'. It is thus on this basis that Marx can, according to Blaug (2012: 287), proclaim that it is the 'hallmark of science … to get underneath the apparent motivation of workers and capitalists on the second floor to the "essence" of the matter on the first floor'. However, for Blaug (2012: 287), this 'is a cunning sleight-of-hand and it has fooled generations of readers' of Marx's *Capital*. Thus, this first claim of Blaug's alleges that Marx has pretended to reveal the essence of the capitalist mode of production. This implies therefore that Marx has failed to reveal it.

Blaug's other claim against Marx (which is a regurgitation of Samuelson's 1971 essay) is made by reference to the Ptolemaic hypothesis and the use of 'epicycles' to help 'save' it as an accurate scientific theory of the solar system and universe despite being a false theory given the Copernican-Keplerian-Newtonian account of the solar system and universe. Blaug (2012: 238) does this with reference to how Marx's 'labour theory of value can … explain all observed price phenomena in a capitalist economy', i.e., to how the observable phenomena of competition in Volume 3 of *Capital* can be explained by a theory about 'invisible' entities (i.e., 'labour values and surplus value') from Volume 1 of *Capital*. Using his Ptolemaic analogy, Blaug (2012: 238) firstly says: 'The skeptic would say that any schema can be made to work at the cost of theoretical complexity: given enough epicycles, even the Ptolemaic hypothesis can be upheld'. So, similarly, Marx's theoretical account of 'price phenomena' (in Volume 3 of *Capital*) based on the 'labour theory of value' (as developed in Volume 1 of *Capital*) can also be upheld by introducing 'enough epicycles', such as by dropping the assumption that all commodities exchange at their 'values' (units of labour-time) and transforming 'values' into 'prices of production' to depict how things look in competition. The implication here is that this still does not save Marx's overall theory of the capitalist mode of production; indeed, no amount of 'epicycles' can save it as an accurate scientific theory of the capitalist mode of production. The principal reason, as Blaug (along with others like Samuelson (1971) and Steedman (1978)) claims, is because of his theoretical failure to successfully transform 'values' into 'prices of production'. It is still, therefore, a false theory. And the upshot of this charge against Marx is that it also implies that he has failed (once again) to reveal the essence of the capitalist mode of production.

Based on these two charges, then, it is Blaug's overall claim that Marx simply fails to reveal the essence of the capitalist mode of production despite his best efforts to save it as an accurate scientific theory of the capitalist mode of production. If Blaug's claim is valid, then Marx's critique of political economy in Volume 1 of *Capital* is not a precursor of contemporary scientific realism. It also means that Marx has failed to emulate the scientific aims and achievements of Newton's work in the *Principia*. Additionally, it cannot be used as the basis on which to acquire some possible theoretical knowledge of the phenomena of the capitalist economic system. But is Blaug right?

Blaug's criticisms of Marx's appearance-essence distinction rests on Marx's labour theory of value being the theoretical heart of Marx's critique of political economy and moreover that Marx's ultimate aim is to explain the phenomena of prices in a capitalist economy (i.e., develop a theory of 'relative prices'). But Blaug has got Marx wrong on his theoretical objective or aim in Volume 1 of *Capital*. Marx's focus is on revealing the economic law of motion of the capitalist mode of production (its central developmental tendency). He does this by revealing how it reproduces itself on an ever-increasing scale based on its underlying social structure (the capital/wage-labour relation and the industrial reserve army of labour). This means that his central theoretical focus is on its underlying causal foundations: its underlying machinery which drives the whole system. Thus, it is not about explaining the price phenomena of capitalism (as might be the case in modern orthodox neoclassical economics).

Despite this, Blaug accuses Marx of trickery or 'subterfuge' in the first instance regarding his distinction between the two levels of the capitalist mode of production in terms of appearance and essence. As I have shown, Marx's distinction is not between something that is unreal and more real (to put it in Blaug's terms) but between how things actually appear on the surface to ordinary observation and how things really are according to science. Hence, the point to grasp about it is that there is a *discrepancy* between the appearance and essence of things (this account of it is missing in Blaug's rendition of it).

This is also an unfair charge to make: it makes Marx seem very dishonest in terms of his main theoretical motive which is primarily to give a scientific account of the capitalist system. It may well be true that Marx has political and moral motives concerning the radical transformation of society, but this does not colour his scientific work in *Capital*. Marx follows the theoretical argument which arises out of his analysis of how the capitalist system works. To do this, Marx (as I have argued) needs to reveal the essence of the system first before going

on to analyse how it appears – but there is no trickery involved. It is hard to see where the trickery of 'subterfuge' is in all this.

Regarding his use of so-called 'epicycles' to save his account of the capitalist system, this only applies if we take Marx's ultimate aim to be about explaining the phenomena of price under capitalism by his labour theory of value. This charge is of course tied-up with Marx's so-called 'transformation problem'. This is a hotly debated issue within both Marxism and mainstream neoclassical economics, as Moseley (2016) discusses. He thinks it, however, is solvable, as have many others before him, like Shaikh (1984) for instance. However, as Lebowitz (2009) points out, too much time has been wasted on this so-called theoretical problem in Marx's work: the real issue is not to solve this so-called theoretical problem of Marx's, but to grasp what Marx has uncovered about the true nature of the capitalist system and to use this knowledge as the basis for a radical transformation of society and the emancipation of the working class from the dominance of capitalists (from capital itself). Moreover, it is not the central aim of Volume 1 of Marx's *Capital* anyway, as the story of Mr. Peel in the last chapter of Volume 1 of *Capital* illustrates. The central aim of Volume 1 of Capital is to show that capitalism cannot exist without a working class to exploit and an industrial reserve army of labour to keep downward pressure on the wages of the working class itself. This is the 'truth' about the capitalist economic system back in the 'motherland' of England that Wakefield reveals through the story of Mr. Peel – and it has got nothing to do with explaining its price phenomena by the labour theory of value. This is the fundamental point that we need to grasp.

We can thus conclude that Blaug's criticisms of Marx's appearance-essence distinction in *Capital* and his conception of the main aim of science are both unfair and off the mark. Marx neither uses 'subterfuge' in the development of his appearance-essence distinction, nor does he use 'epicycles' to save his theory of how capitalism works.

6.2 Is Marx's critique of political economy an 'exact' or 'inexact' science?

We now turn to an issue which pertains to Marx's critique of political economy as a 'work of science'. Specifically, is it an 'exact' or an 'inexact' science, as articulated by Rosenberg (2012a and 2012b)? To discuss this issue, I shall first expound what Rosenberg takes an exact science to be and how it differs from an inexact one.

Rosenberg's conception of exact and inexact sciences is based on his distinction between exact and inexact laws. For Rosenberg, a law of nature is not an accidental generalisation; it is a

constant conjunction of cause and effect events based on a causal foundation and a necessary connection. It is therefore an exact law.

For Rosenberg, these laws are universal statements that apply everywhere and always in all spaces and times; there are no exceptions – they always operate in the same way everywhere. Newton's three laws of motions and his universal law of gravitation are for him examples of such exact laws of nature. For Rosenberg, physics and chemistry are generally held to be exact sciences because they contain exact laws of nature.

An inexact law, however, is one which depends on *ceteris paribus* conditions ('all things remain the same'), as found in biology and the social sciences in general. For Rosenberg, they require many qualifiers and conditions to be in place for them to hold. Any work of science which operates with 'inexact laws' is deemed to be an 'inexact science'.

According to Rosenberg, a law of nature allows scientists to make precise predictions about phenomena (in all times [past and future] and spaces [near or far away]), such as the predictions of the motions of the planets of our solar system and the position of stars in the universe (at the macroscopic level of the universe) – although this is only true up to a point given that there is no general solution for the three body problem – or position and charge of sub-atomic particles like the electrons and quarks in an atom (at the sub-microscopic or quantum level of the universe) – although this is not completely true either given the example of Heisenberg's principle, which means that you can only get precise predictions of one variable at the cost of less precise predictions of another related variable.

Accordingly, laws of nature take either (i.e., they can be expressed in) the following logical forms: (1) 'if P then Q' or (2) 'All Fs are Gs'. For Rosenberg (2012a: 45), the former expresses 'facts that can obtain anywhere or at any time', whilst the latter means 'that anything … that [has] … the property of F will also have … the property G'.

For Rosenberg (2012a: 45), laws of nature also rest on 'the underlying machinery of nature … that always operates in the same way everywhere'. In other words, the laws of nature are based on causal foundations. It is the underlying causal foundations which constantly determine the observable operations of the laws of nature. If the underlying causal foundations are not in place, then the laws of nature will not be constantly operating. This is a very Humean view of things, as Hume too holds that the 'constant conjunctions' of cause and effect events are based on some sort of 'secret power' or 'tie' (the unknowable essence of phenomena).

For Rosenberg (2012a: 45-6), there are four conditions which need to be satisfied if a lawlike statement is to be called a law of nature (an exact law):

1. Is the candidate a true universal conditional that makes no mention of specific places, times or things?
2. Is the candidate a contingent statement the denial of which is conceivable, as opposed to a definition or the consequence of definitions that cannot report causal relations?
3. If the candidate is true only because of a *ceteris paribus* statement, can we expect to narrow the range of its exceptions by empirical means?
4. Does the candidate support counter-factual conditional statements?

If, for Rosenberg (2012a: 46), 'the answers to all of these questions are yes, we have a law.'

There is, however, an alternative view about the laws of nature (or laws of science or the laws of physics) as propounded by Cartwright (1989 and 2002 [1983]). For her, there are no laws of nature, just dispositions or tendencies or capacities or powers based on causal foundations. A standard example, for Cartwright, is aspirin or a piece of glass. Aspirin, given its particular molecular make-up, has the capacity to relieve headaches. A piece of glass, given its particular atomic-molecular make-up, has the capacity to break on being struck. In both cases, each item has the capacity to act or behave in a certain way as a result of its particular causal make-up (or causal foundations). In both cases, if the particular causal make-up is missing, then that particular item will not produce certain effects. What is thus important to note here is that, given the particular causal make up of something, it has the capacity to produce certain effects. So, the emphasis here is on discovering what are the causal foundations of something which determine its capacity to produce certain effects. This is a very Lockean view of things, as Locke too holds that the 'powers' of things have their causal origins in their inner constitutions (real essences), and it is these that we need to know if we want to understand how something has the power to produce a certain effect.

Given this account of Cartwright's, science is not necessarily an exact body of work as found in Rosenberg's description of an exact science. Nevertheless, its virtue or advantage is that it allows more leg room for saying that while a particular piece of scientific work is not an exact science *à la* Rosenberg since it cannot produce exact laws of nature, it is still a work of science since it is able to explain the capacities of something on the basis of its underlying causal foundations.

So, what is Marx's work? Is it an exact or inexact science? On Rosenberg's account, it is not an exact science since its various economic laws like 'the law of capitalist accumulation' are not, compared to Newton's three laws of motion and his universal law of gravitation, exact laws of nature. As a consequence, they are unable to make precise predictions. At best, they can only suggest on *ceteris paribus* conditions what will probably happen, such as if there is both a concentration and centralisation of capital then there will be a widening gap between the relative wealth of capital and the relative poverty of labour – as predicted by the absolute law of capital accumulation. But on Cartwright's account, it does not really matter *if* it reveals the 'dispositions' or 'tendencies' of things based on their causal foundations. As we have seen, on the basis of an analysis of the underlying causal foundations of the capitalist mode of production (its social structure) Marx shows that capitalism necessarily tends to produce a capitalist accumulation process. This process of capitalist accumulation is based on many contingent factors, such as whether capitalists have enough workers to exploit or can keep the costs of wages down. It is therefore not an 'iron law of nature', as Marx himself admits. Nevertheless, this process tends to arise under capitalism because of its underlying causal foundations (its social structure). If these are not in place, then it will not produce any capital accumulation. You cannot, to put it in Hegelian terms, have one without the other. So, while Marx's analysis of capitalism is not an exact science in Rosenberg's sense, it is still a science in Cartwright's sense since it shows a causal link between the underlying causal foundations of capitalism and its central economic tendency. In short, it provides a causal explanation of the central economic tendency of capitalism, as summed up in the absolute law of capitalist accumulation.

We can therefore conclude that while Marx's analysis of capitalism is not an exact science in Rosenberg's sense, it is nevertheless in Cartwright's sense a science because it has causally explained its economic tendencies (as expressed by such laws of motions as the absolute law of capital accumulation) on the basis of its underlying causal foundations (its social structure). In that sense, Marx is still meeting the principal requirement of any science, which it to reveal the causal foundations of phenomena (their essence).

6.3 An issue about my own account of Marx's critique of political economy in Volume 1 of *Capital*

Finally, I shall now consider the following possible objection to my own account of Marx's critique of political economy in Volume 1 of *Capital*. It is this: have I engaged, as Choonara

(2017: 19) puts it, in 'a crude focus on production, in which issues related to the circulation of capital or questions such as finance and credit that are mainly discussed in Volume 3 [of *Capital*] are overlooked'?

It is clearly true that I have focused solely on the first volume of Marx's critique of political economy in *Capital*. I have done this for a few reasons.

Firstly, it is the only completed and published volume of Marx's critique of political economy in his lifetime; the other two volumes, plus the three parts comprising his *Theories of Surplus-Value*, have all been published posthumously and edited by others. Therefore, they are not completely reliable texts on which to base every conclusion regarding Marx's theoretical points about the nature of the capitalist mode of production.

Secondly, my focus in this part of the thesis on Marx's critique of political economy has been a narrow methodological one. It has been solely focused on Marx's methodological insight which he derives from the Newtonian-Keplerian account of the solar system: before it is possible to study the outward appearances of phenomena, we must first uncover their underlying essence (their causal foundations). This, accordingly, is for Marx the primary aim of science; if this is not first done, then it will be impossible to acquire some theoretical knowledge of the phenomena of the world. Consequently, in terms of Marx's critique of political economy in *Capital* this means a principal focus on Volume 1, which is mostly about what goes on in the sphere of production and accumulation. For it is here, as I have shown, that Marx emulates Newton's scientific approach by analysing the underlying essence of the capitalist mode of production. And it is this which, according to Marx, we must first understand if we are to then give a scientific account of what goes on in competition between capitalists, as Marx seeks to do in his unpublished version of Volume 3 of *Capital*.

Thirdly, just because I have narrowly focused on Volume 1 of *Capital* in his critique of political economy, it does not follow that I (in principle) ignore the other two volumes of *Capital*. It is just not a necessary part of my narrow methodological focus in this part of the thesis on Marx's critique of political economy. But, of course, if we are to give a more comprehensive account of Marx's critique of political economy in terms of his distinction between appearance and essence, then we would need to look at the methodological relationship between Volumes 1, 2 and (especially) 3 of *Capital*. For in doing so, we would come to see how, as Marx (1981: 117) himself says:

> The configurations of capital … thus approach step by step the form in which they appear on the surface of society, in the actions of different capitals on one another, i.e. in competition, and in the everyday consciousness of the agents of production themselves.

Finally, to establish that Marx's critique of political economy in Volume 1 of *Capital* is a precursor of contemporary scientific realism then such a narrow methodological focus is enough to do this.

6.4 An initial conclusion

Overall, then, we can conclude that Marx's distinction between appearance and essence and his conception of the central aim of science are both defensible. Consequently, his critique of political economy in Volume 1 of *Capital*, although not an exact science, is defensible too.

6.5 How Marx's critique of political economy is a precursor of contemporary scientific realism

I shall now draw out how Marx's critique of political economy is specifically a precursor of contemporary scientific realism.

In Volume 1 of *Capital* Marx (as we have seen) seeks to emulate the scientific achievements of Newton regarding his scientific account of the solar system. To recall, Newton not only shows there is a discrepancy between the apparent motions and real motions of the heavenly bodies but also is able to give a scientific explanation of how and why the heavenly bodies of our solar system (the earth and moon included) all orbit around the sun or (to be more precise) the actual centre of the solar system in ellipses – the actual centre of the solar system (its centre of gravity) is near the centre of the sun. To do this, according to Marx, we must go beyond the immediate impressions of our senses to discover what is the real causal foundations of phenomena. This is what Newton has done, although, not completely, considering Einstein's theory of general relativity. Newton is therefore a scientific realist given what we take scientific realism to be in a contemporary philosophical sense: Newton has sought to discover the underlying causal foundations of phenomena – the hidden causal structure which gives rise to the observable phenomena of the world. That is what makes Newton a scientific realist. If he had not aimed to do this, then he would not be a scientific realist at least in terms of what are the principal aims of science. He is also a scientific realist in practice and not just in principle. That is, his actual scientific practice (his actual scientific achievements) fall into a scientific

realist basket – in short, he satisfies the criteria of what makes a 'scientific work' a *scientific realist* one as opposed to something else, say, a positivist one (which is focused upon discovering the connections of phenomena only rather than uncovering any deep causal structures or mechanisms or foundations that might give rise to the observable phenomena of the world).

You could say (and perhaps should say) with regards to the issue about whose work in science is a precursor of contemporary scientific realism, that Newton's scientific work is the original precursor of contemporary scientific realism. However, since the focus of this part of the thesis is on Marx's critique of political economy in Volume 1 of *Capital* – on his actual scientific work – and not on Newton's, then the focus for us is on whether Marx's work is also a precursor of contemporary scientific realism.

In seeking to emulate Newton, Marx is thus embarking upon a scientific realist project: he too is seeking to uncover the hidden causal structure which gives rise to the observable phenomena of the world. This is what he aims to do in Volume 1 of *Capital*. Marx shares the aims of contemporary scientific realism – which holds that science's central aim is to uncover the hidden causal structure which gives rise to the observable phenomena of the world. However, I also want to say something stronger than this since we are all 'scientific realists' if we take it to be the central or principal aim of science to discover the hidden causal structure which gives rise to the observable phenomena of the world. What I want to say is that Marx has in fact revealed the hidden causal structure which in turn gives rise to the observable phenomena of the world in capitalism – which is what contemporary scientific realism claims is sometimes possible in science. So, just like Newton before him, albeit in a very different type of science, I want to claim that Marx not only holds the view that science should aim to reveal the hidden causal structure of the observable phenomena of the world but also that he has in fact revealed it with regards to capitalism. Thus, Marx has fulfilled or satisfied the basic criteria of contemporary scientific realism in terms of both (1) its central aim (to reveal the hidden causal structure which gives rise to the observable phenomena of the world) and (2) its actual achievements in giving a scientific realist account of capitalism. *It is not just that Marx's critique of political economy aims to be scientific realist but is in fact scientific realist.*

Of course, Marx has done this all within a specific philosophical framework which is both Hegelian in origin and in keeping with the Lockean scientific realist trend in the philosophy of science which his type of empiricism lays a basis for. The Hegelian aspect of his scientific

realist project in his critique of political economy is to draw a distinction between the appearance and essence of things and to see the sphere of circulation and exchange as constituting the world of appearances while the sphere of production and accumulation constitutes the world of essence and that the two spheres are necessarily connected. Its Lockean aspect is to see that the observable phenomena of the world and its various features – their nominal essences – have their causal foundations in their unobservable, inner constitutions – their real essences. Marx's account of the essence of capitalism shows that we can also have theoretical knowledge of capitalism, even if it is minimally quantitative relatively to physics.

6.6 Conclusions

In this second part of the thesis I have shown that Marx not only (1) aims to uncover the essence of phenomena which lies hidden behind its forms of appearance but also (2) has in fact done so with respect to revealing the underlying causal foundations of the capitalist mode of production via the economic law of motion of modern capitalist society – the absolute law of capitalist accumulation. To put this in terms of contemporary scientific realism, Marx has not just aimed to uncover the underlying or hidden causal structure of the capitalist mode of production which, in turn, gives rise to its observable phenomena (which is the defining methodological aim of contemporary scientific realism), but has in fact done so (which is what contemporary scientific realism claims is sometimes possible in science). So, we can conclude that Marx's critique of political economy in Volume 1 of *Capital* is, indeed, a precursor of contemporary scientific realism.

Marx has shown, if you want to give a complete account of phenomena then you must do so based on their causal foundations (essences) – which means you need to go beyond immediate experience (appearances) – since this is how we can acquire some possible theoretical knowledge about them. Thus, the methodological project of Marx's critique of political economy as it applies to an account of capitalism is something to emulate, just as Marx has attempted to emulate the methodological project of Newton's scientific account of the real motions of the heavenly bodies of the solar system – despite the fact that Marx's account is incomplete in a way that Newton's is not, since only drafts were put together for Volumes 2 and 3.

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